THURSDAY, DECEMBER 6, 1894.

PECULIARITIES OF PSYCHICAL RESEARCH.

Apparitions and Thought Transference. By Frank Podmore, M.A. (London: Walter Scott, 1894.)

MR. PODMORE, in the opening chapter of this popular exposition of telepathy, pleads for the recognition of psychical research by the general body of scientific workers. He reminds us of the opposition geological and biological discoveries have encountered, and ventures to compare the circumstances of the small group of investigators with which he is connected, and more particularly the prejudice and derision they encounter, with the experiences of Cuvier and Agassiz. Convincing as this comparison may appear to the general reader, in one respect at least it fails. Three hundred years ago, all these phenomena of crystal gazing, thought transference, and apparitions had a broader basis of belief than they have to-day; even a hundred years ago, the ordinary scientific investigator was at little or no advantage over the exponent of magic arts. But though, as Mr. Podmore reminds us, the leading propositions of natural science once encountered popular prejudice, ridicule, contempt, hatred, far more abundantly than has ever been the lot of psychical interpretations, they have won through and triumphed, while the credit accorded such evidence as the S.P.R. accumulates has, if anything, diminished. A thing Mr. Podmore scarcely lays sufficient stress upon is the fundamental difference in the quality of the facts of "psychical research," as distinguished from those of scientific investigation—using scientific in its stricter sense. It is true he has, with an appearance of frankness, devoted a chapter to "special grounds of caution," in which he concedes the truth of various criticisms, and owns to several undeniable impostures; but even here he passes from admissions to a skilful argument in favour of telepathy, and avoids the cardinal reason for keeping aloof from this field of inquiry, that lies in the quality of the evidence.

The scientific advances of Cuvier and Agassiz, like all true scientific discoveries, were based upon things that could be perceived directly by themselves, and which could be reproduced whenever required, and completely examined under this condition and that, by those who doubted the facts. That is the essential difference between natural science and such a subject as history; science produces its facts, history at best produces reputable witnesses to facts. Scientific men have never attached much importance to unverifiable statements, however eminent the source. If, to suppose an instance, the greatest living anatomist were to announce that he had dissected a dogfish and discovered lungs therein, adduce his wife, a local general practitioner, two servants, and a lady "named Miss Z." in evidence, and add that he had lost the specimen, there can be scarcely any doubt that, in spite of his position and his character, the science of anatomy would remain exactly where it was before his discovery was proclaimed. But in this "psychical research" the deliberate reproduction of phenomena under conditions that admit of exhaustive sceptical examination appears to be generally impossible, and we are repeatedly asked to form opinions on the hearsay of Mr. Podmore and his fellow-investigators.

This is not all. Few of the phenomena are directly observed. Dr. Dee had his Kelly, Prof. Oliver J. Lodge his Mrs. Piper. If Prof. Sedgwick would read the thoughts of Prof. Oliver J. Lodge, or—as a phantasm of the living—take to haunting some sceptical person, we should have at least a statement at first hand, to doubt; but as it is, these investigators manifest, as a rule, no other mental phenomena than belief and repetition. Reading through Mr. Podmore's book, the student will be struck by the fact that the persons who are in immediate contact with the alleged phenomena, the hireling eyes of the psychological inquirer, are persons usually youthful and coming from a social level below that of the investigators. Take, for instance, the Guthrie cases, to which Mr. Podmore attaches considerable importance. Mr. Guthrie is a draper in Liverpool, and by some means, not stated, he became aware of psychic powers possessed by two of his employees—young ladies—whose identity is for some reason veiled under the initials "E." and "R." These young ladies were accordingly liberated at intervals from the toils of shop or workroom, and made the subjects of various experiments; Mr. Guthrie, for instance, putting cayenne pepper in his mouth, during a profound silence. and Miss E. experiencing a taste of "mustard." Now we must insist upon the fact, because it seriously affects this question of evidence, that to a young lady following the irksome and precarious calling of a draper's assistant, the manifestation of psychic gifts opens up eminently desirable possibilities and interests. Then, among other of these intermediaries, we find "Jane"—a pitman's wife—"Bertha J.," a peasant woman, hospital nurses and out-patients, two men "who had been subjects of an itinerant lecturer upon hypnotism," most of the letters of the alphabet, several American M.D.'s, lady medical students, a baker's assistant, Mr. P., "a clerk in a wholesale house, aged nineteen, who possesses a good deal of humour," and so forth.

Scarcely ever is the medium a person really independent, in a financial sense, of the investigators who are craving for phenomena. It is necessary for us to believe in the general good faith of this extremely dubious material, or in the adequacy of the precautions against fraud taken by persons whose scientific reputations are now hopelessly bound up with the reality of the alleged facts, before one can even begin to accept the experimental basis upon which the theory of telepathy rests. And this is the character of the investigations that Mr. Podmore has compared with the work of Cuvier and Agassiz! In no other field of inquiry is so much faith in personal character and intelligence demanded, or so little experimental verification possible. Indeed, the book is oddly suggestive in places, with its use of initials and second-hand guarantees of character, of the testimony one finds adduced in favour of patent medicines.

Now, to the attentive reader of Mr. Podmore, the persuasion is unavoidable that the ordinary psychical investigator is endowed with a considerable facility of belief, and is by no means instinct with the scientific method. And this, where we are to take very much on faith, is a material consideration. Anonymous statements

are accepted, and not only anonymous but self-contradictory ones. Mrs. Piper hypnotised, personated a French physician Dr. Phinuit, who did not know French, and failed to give a satisfactory account of himself. Mrs. Piper, during her trance as Dr. Phinuit, gabbled, made chance shots, "fished" for information, and was generally a transparent enough imposition. Yet she occasionally spoke of things she could not, according to the investigators, have obtained a knowledge of by ordinary means. For that they give her credit, and forgive all her failures. Prof. Lodge, apparently eager to believe, compares her utterances to the experience of anyone listening at a telephone: "you hear the dim and meaningless fragments of a city's gossip till back again comes the voice obviously addressed to you, and speaking with firmness and decision." Imagine in a real scientific inquiry an investigator pursuing a theory through a complicated series of observations, arbitrarily selecting those that advance his views, and calling the others "dim and meaningless until back comes the result obviously addressed to you!"

As one instance of the absence of scientific method from these discussions, take M. Richet's and Mr. Gurney's experiments with cards. In these experiments an agent looked at the card, and a percipient guessed the suit. M. Richet conducted 2927 trials, and 789 correct guesses were made, the theory of probability only granting 732. The S.P.R. trials numbered 17,653, with 4760 successes—347 in excess of the probable number. Now this is adduced by Mr. Podmore as evidence for telepathy; we are asked to believe that about once in sixty times—that is the excess above the probable ratio of successes—the mental impression of the agent recorded itself upon the brain of the percipient. Whether during the interval of fifty-nine trials telepathy was in abeyance, Mr. Podmore does not say, and the failure of the American S.P.R. to confirm these results he sets aside because the details of their experiments are not given—an excellent example to the sceptic. Are we to believe that only once in sixty times did the transferred thought surge up into consciousness, or that the transference occurs only at the sixtieth time, or what? A most obvious collateral test seems to have been altogether overlooked, namely, for someone to guess cards *before* the agent saw them, and so to ascertain how far pure haphazard guessing of this kind, or guessing on any particular gambler's "system," may fall away from the theory of probability. The deductions of the theory of probability, be it remembered, become certainties only when the number of cases is infinite. We have no grounds for assuming that in seventeen thousand or seventy thousand, or in any finite number of cases, facts come into coincidence with this theory. In an infinite number of sets of 17,653 trials we might have every possible divergence from the average result up to 17,653 successive failures or 17,653 successive successes. Taking a number of sets, they may be expected to fluctuate round a mean result in agreement with the theory of probability—that is all. These three sets of experiments manifestly prove nothing. And this is how Mr. Podmore prefaces his account of them: "In the following cases, where the exact nature of the impression received was not apparently classified by the percipient, it may be presumed to have been either of a visual or an auditory nature." He begs the question, and in a book addressed to the untrained mind of the general reader! Nothing could show more clearly the tendency of this psychical research to accept as evidence what is really not evidence at all, its lack of critical capacity and severe confirmatory inquiry, and the missionary spirit of its exposition.

Enough has been said to show the essential difference between "psychical" and scientific investigations, and to justify the attitude of scepticism. After all, that scepticism does nothing to hamper Mr. Podmore and his associates from collecting their evidence, clarifying their opinions, and building up such a defensible case as their peculiar circumstances permit. And be it remembered the scientific man of to-day occupies a responsible position, that he possesses even a disproportionate share of the public confidence, because of his reputation for sceptical caution. The public mind is incapable of the suspended judgment; it will not stop at telepathy. Any general recognition of the evidence of "psychical" research will be taken by the outside public to mean the recognition of ghosts, witchcraft, miracles, and the pretensions of many a shabby-genteel Cagliostro, now pining in a desert of incredulity, as undeniable facts. Were Mr. Podmore's case strong—and it is singularly weak—the undeniable possibility of a recrudescence of superstition remains as a consideration against the unqualified recognition of his evidence.

H. G. WELLS.

THE BEGINNINGS OF HISTORY.

The Dawn of Civilisation—Egypt and Chaldæa. By G. Maspero. Edited by A. H. Sayce. Translated by M. L. McClure. (London: Society for Promoting Christian Knowledge, 1894.)

AS the winter season advances, and folk begin to wend their way to Egypt, the enterprise of authors and publishers keeps up a steady supply of good literature concerning the country which, since the English occupation in 1882, has exercised upon people of all nations a fascination which may be described as marvellous. Only a few weeks ago an English translation of Dr. Erman's *Aegypten* appeared, and already we have before us a translation of a very important work by Prof. Maspero in the same language. Both works are excellent, but each is typical of the nationality of its writer, and is really addressed to a different class of readers. The work of Dr. Erman possesses a minuteness of detail characteristic of the true German student, laborious and accurate, while that of M. Maspero, though no less accurate, discusses facts on a large scale with due reference to everything which bears upon them, and contains generalisations which all thoughtful readers will accept with gratitude; added to this, we have the light and easy style and logical arrangement of facts and sentences which are the type of the work of the French master of his subject. In short, Dr. Erman's book will form a standard work of reference for the student of Egypt; but that of M. Maspero will take its place as a general history of early Oriental civilisation on the banks of the Nile, Tigris, and Euphrates, and in the countries which lie between.

The volume which we have in our hands, although it is nowhere stated in it, seems to be the first of a series which M. Maspero intends to devote to the history of the ancient nations of the East; and indeed the original French work began to appear in weekly numbers with the general title of *Histoire Ancienne des Peuples de l'Orient* some time ago. It is necessary to state this in order that the reader may not confuse the new work of M. Maspero with the small and older work, the first edition of which appeared in Paris so far back as 1875, for although both books run on the same lines, and have the same aim, and the smaller originated the idea of the larger, yet the scale of the new work has been so greatly increased that it practically forms a new and independent treatise on Oriental history and archæology. The first work ran through four editions at least, and was exceedingly popular; but the new work, with its beautiful illustrations, is intended to be in France what Rawlinson's "Ancient Monarchies" was in England.

M. Maspero divides the first volume of his history into two parts: the first treats of Egypt, and the second of Ancient Chaldæa, six chapters being devoted to the former subject, and three to the latter. A detailed description of the formation of Egypt as a land is followed by an account of the Nile and of its influence upon the history of the country and its people. The civilisation of Egypt, according to M. Maspero, sprang up in the country on the banks of the Nile, which was bounded by Gebel Silsila on the south, Buto in the Delta on the north, the mountain of Bakha on the east, and the mountain of Manu on the west. The origin of the people who produced it is difficult to trace, for the camp of Egyptologists is divided in opinion on the matter. Many scholars hold that the Egyptians came from Asia, but not all who are of this opinion agree as to the route followed by them into Egypt. Some would have them enter Egypt by the Isthmus of Suez, and having gained possession of the Delta, make their way up to Memphis, Heliopolis, and further south; others would have them cross the Red Sea to Kosseir and so thence to Coptos, and thus account partially for the traditions which made Abydos in Upper Egypt the oldest city in Egypt; and again, others would make them cross over from the Arabian Peninsula by the Straits of Bâb el-Mandeb into Africa, and skirting the Abyssinian mountains, enter Egypt from the south. The first theory holds water so long as we assume that the Egyptians made their way from the East by the old trade routes into Egypt through Syria; in fact, this would be their only way if they set out from countries on about the same parallel of latitude as Babylon, for the want of water in the desert between the Euphrates and Egypt has from time immemorial made the route impossible even for the armies of mighty kings, and every invasion of Egypt by peoples from this region has been made by the way of northern Syria. The second theory makes it necessary for the emigrants from Asia to have crossed the waterless desert in the Arabian Peninsula, and to have built boats sufficiently large to cross the Red Sea; this appears to be the most improbable of all the theories yet put forth. The third theory has much in its favour, for the passage across the Straits of Bâb el-Mandeb would be easy, and the distance from shore to shore was probably less in those days than now. There exists yet another theory, however, as to the Asiatic origin of the Egyptians. In a paper read at the Oriental Congress in 1892, Dr. Hommel boldly asserted that the Egyptian civilisation was derived from that of Babylon, and he attempted to prove that the names of the gods of the one country were but slightly modified forms of those of the others. Egyptologists have not, up to the present, accepted this theory. A still more remarkable theory is that of Reinisch, who believes that Asiatics, Europeans and Africans spring from one family, whose original home was in the heart of Africa, near the great equatorial lakes. M. Maspero does not accept the theory of an Asiatic origin, but rather believes that the Egyptian

"population presents the characteristics of those white races which have been found established from all antiquity on the Mediterranean slope of the Libyan continent; this population is of African origin, and came to Egypt from the west or south-west. In the valley, perhaps, it may have met with a black race which it drove back or destroyed; and there, perhaps, too, it afterwards received an accretion of Asiatic elements, introduced by way of the isthmus and marshes of the Delta."

The caution with which M. Maspero puts forth this theory shows that he has some doubts about it, and, indeed, leaves the question exactly where it was. As to the relationship between the Semitic languages and the language of the hieroglyphics, he has no doubt that at one time they all belonged to the same group; the latter, however, separated from the former very early, "at a time when the vocabulary and the grammatical system of the group had not as yet taken definite shape." This is an important pronouncement for an Egyptologist to make, and although it was said long ago by Semitic scholars, it is none the less welcome since it comes from one of the first Egyptologists of our times. Passing from the origin of the people to their religion and manners and customs, M. Maspero concisely and graphically describes their gods and mythology, and the beliefs which swayed the minds of the Egyptians for several thousands of years. The size of M. Maspero's work and the limits of a brief article absolutely preclude the possibility of noticing many new points in these subjects, which are admirably described, and we rapidly pass from the account of the political constitution of Egypt to the historical section of this division of the book, which treats of the first fourteen dynasties.

The second part of the volume follows the plan of the first, and sets out by describing the country, people, gods, &c., of the ancient Chaldæans, or more properly Babylonians, and the chapter which treats of their ideas concerning the Creation is of considerable interest. In this M. Maspero has rightly relied upon Jensen's epoch-marking book, "Die Kosmologie der Babylonier," for information, but it is to be regretted that Zimmern's translations of the "Creation" and other tablets were not published in time to be used by him. M. Maspero is, however, the first to describe popularly the excellent results achieved by Jensen in a subject which before he treated it was truly chaos. Passing to historical times, M. Maspero describes the foundation of the Babylonian empire, basing all his statements upon a series of works by Assyriological authorities, and cleverly harmonising

their various opinions. The chapter on the Chaldæan civilisation is interesting, and is full of curious information. The volume is concluded by an appendix treating of the Pharaohs of the Ancient and Middle Empires, and by a useful index. M. Maspero is fortunate in having found so careful a translator as Mrs. McClure, who introduces her work in a preface which is at once business-like and to the point. The editor's remarks are, however, somewhat rambling, and in professing to criticise M. Maspero's knowledge of matters Egyptian or Babylonian, we think greatly out of place.

THE TRANSMISSION OF POWER.

On the Development and Transmission of Power. By William Cawthorne Unwin, F.R.S. (London: Longmans, Green, and Co., 1894.)

IT is well known that the author of this work has had special opportunities for studying the subject of transmission of power by all the various methods which have, at different times, been adopted, and the engineering world is to be congratulated on having received from his pen a summary of the principles utilised in this class of work, and of the possibilities of the future, as well as very complete and authentic information about the principal work that has been done in the past. This book is the outcome of a course of "Howard" lectures delivered before the Society of Arts in 1893. It deals with the generation, storage, and transmission or distribution of power. The methods of transmission and distribution include water under pressure, compressed air, wire ropes, steam, gas and electricity. The author recognises the fact that transmission of power to distances has not been so fully developed in the past as it is likely to be shortly, and that the electrical transmission and distribution of power has more to claim in the way of promises for the future than large achievements in the past.

The first chapters deal with the generation and the cost of generating power by steam or hydraulically. One of the most valuable parts of the book is found in those chapters where the economy of steam engines is considered. These chapters deal with the losses in boiler and engine in a very complete manner. The author has realised very fully the fact that in any case of generating power in large quantities, and distributing it to small consumers, the cost of the horse power depends largely upon the load curves at different times of the day, and he draws attention to the very large excess of cost per horse power of electric lighting stations over those which are delivering power at a constant rate. Even in a pumping station where the work is continuous, he finds that about 35 per cent. more fuel is required than in a careful trial, but in a station from which electric light or power is distributed, the losses due to banking of boilers and to engines working a portion of their time at an output which is not economical, are such that the quantity of fuel used per indicated horse power rises from $1\frac{1}{2}$ lbs. per hour in a test trial with a condensing engine, to 3·3 lbs. under the special circumstances. The relative advantages of the condensing and non-condensing engines of the simple, compound, and triple expansion engines, of the steam-jacketing and superheating, are all discussed admirably. Some pages also are devoted to the utilisation of house refuse as a fuel, and the Halpin system of thermal storage receives some attention.

Some of the most important cases of utilising water power are also discussed. It will surprise many readers to find that even in 1876, 70,000-horse power was generated for manufacturing purposes from waterfalls in Switzerland, and that in the United States in 1880, 36 per cent. of the power used in manufacturing was water power, and only 64 per cent. steam power.

Among the chapters devoted to transmission of power, the most important, as pertaining more especially to the author's experience, are those on hydraulic and compressed air transmission. But in all branches of the subject, not only are the general principles dealt with, but there is to a pretty full extent a recapitulation of what has already been done. The London Hydraulic Power Company is taken as the best example of hydraulic transmission, but Liverpool, Birmingham and Manchester are also referred to, whilst most interesting accounts of the hydraulic supply at Zurich and Geneva are given. The principles of pneumatic distribution are very completely described, and the author has certainly made out the case that when these principles are properly applied, this system of distribution deserves more consideration than is generally accorded to it. Naturally the Paris distribution by this method is dealt with very fully, but other examples of interest are added. With regard to the distribution of power by steam, the most important case is that of New York, which Dr. Emery started in 1881. Eight pages upon gas distribution for power purposes are well worth some study, whether with regard to manufactured gas, or the natural gas supply in Pennsylvania. Whilst compressed air receives the author's attention to the extent of forty-eight pages, electrical distribution is by no means so well favoured; but the author explains that, in the first place, it is not his own speciality, and, in the second place, there are at the present moment few cases of electrical transmission combined with a complete system of distribution in a town. A chapter is at the end devoted to the great work which is now approaching its full development at Niagara Falls.

This short review cannot pretend to give an adequate idea of the contents or value of Prof. Unwin's book. Regarding the merits of the work generally, it is sufficient to say, first, that throughout it is written with the utmost fairness and impartiality; and secondly, that if any engineer were planning a system of transmission and distribution of power in any special case, he would be labouring under very considerable disadvantages if he had not first consulted this latest and most complete work on the development and transmission of power. G. F.

OUR BOOK SHELF.

A Treatise on Hygiene and Public Health. By Thomas Stevenson, M.D., F.R.C.P., and Shirley F. Murphy. (London: J. and A. Churchill, 1894.)

THIS volume is devoted to the subject of sanitary law, and it well maintains the all-round excellence of the two volumes that preceded it. Health officers will welcome the appearance of such a lucid and comprehensive digest of the law relating to the public health in England and Wales, Ireland and Scotland.

During comparatively recent years an immense amount

of piece-meal legislation bearing upon the public health has been passed; that much of this legislation, despite subsequent amendments, still remains obscure and unsatisfactory is clearly shown in the results of proceedings undertaken by those whose duty it is to put it in force. What cause to wonder, then, if the lay reader, by reason of obscurities in the particular Act itself, or from the fact that either amendments have been introduced by succeeding enactments or the particular Act is itself an amendment of earlier statutes, becomes bewildered, and a laudable desire to master an important subject is nipped in the bud? Those who are concerned in the administration of this branch of the law have frequent occasions to regret the lamentable ignorance existing among all sections of the community as to their powers and liabilities in matters which may seriously affect their vital interests. Any simplification and consolidation, therefore, more especially when it is undertaken, as in this instance, by gentlemen of recognised legal ability, should prove very welcome not only to health officers, but also to the general public.

The decisions of the authors of the work to collate the various provisions contained in different enactments dealing with the same subject, and to present these—so far as possible—freed of all legal phraseology, was a happy one; it makes the work unique in its serviceability to the lay reader, who will gain from its perusal a clearer and more definite knowledge of the public health laws of the different parts of the United Kingdom than he would succeed in doing—at a much greater sacrifice of time and patience—from any other publication dealing with the same subject.

Involution and Evolution according to the Philosophy of Cycles. By Kalpa. (London: Eyre and Spottiswoode, 1894.)

THIS is one of the books that most people would be glad to lay aside, and, indeed, it is very difficult to say with what object it has been written. The cycles decribed have nothing to do with approximate commensurability of planetary motions, and certainly not with evolution as understood in the modern acceptation of the term. The author is a disciple of the school of Mdme. Blavatsky, and draws his inspiration from that source, tinged, it may be, with something of esoteric Buddhism, and a good deal "spider-wove from his own brain." If anyone wants to know what absurdities modern theosophy is capable of, by all means let him read it, but most people will be satisfied to take the contents at second-hand. A very objectionable feature in the book is the occasional quotation at the heads of chapters of extracts from recognised writers of authority, conveying the impression that the contents of the chapters following are based upon modern science, and would meet the approval of the authors from whom the quotations are made. One illustration will be sufficient to show the style of the author's reasoning and the character of the information conveyed. The particular object is to demonstrate the birth of comets and worlds (p. 148). "But the least subtilised type of those disembodied groups does not take the same direction as the others. It keeps going in orbits round the sun, shooting beams at him, which, expelled (seemingly, at least), spread out behind as a lengthy tail. Then, when the sun takes a short rest, his brilliancy nearly spent, that entity moves off, its beams showing the way, but greatly reduced, and of which nought remains ere the *comet* disappears for parts unknown. It will be known to us as comet I." We have, approximately, 200 pages of this sort of stuff, paragraph after paragraph, all of which are utterly incomprehensible, and to wind up the whole we have sheet after sheet of diagrams or illustrations which no man can understand, and on which we should imagine the author himself would pass a very doubtful examination.

The Mountains of California. By John Muir. Pp. 381. (London: T. Fisher Unwin, 1894.)

FEW regions offer more remarkable subjects for the student of nature than the State of California. There are the two great mountain ranges—the Coast Range on the west, and the Sierra Nevada on the east. Great cañons furrow the latter to depths of from two thousand to five thousand feet, and in the middle of the deepest of them flourish the Sequoia, the noble sugar and yellow pines, Douglas spruce, Libocedrus, and the silver firs, each a giant of its kind. Floods of lava cover the north half of the High Sierra, and volcanic craters, recent and in all stages of decay, are dotted over it. Mount Shasta is one of these volcanic cones, rising to a height of more than fourteen thousand feet above sea-level. Deep grooves flute the sides of the mountains, and testify to glacial erosion. It appears that so far south as latitude thirty-six degrees, traces of glacial action abound. Mr. Muir has found sixty-five residual glaciers in the portion of the Sierra lying between latitudes thirty-six and thirty-nine degrees. The first one of these was discovered by him in 1871 between two of the peaks of the Merced group. He also determined the rate of motion of the middle of the Maclure glacier, near Mount Lyell, to be but little more than an inch a day. Mount Shasta has three glaciers; while Mount Whitney, though the highest mountain in the range, has none.

The special features of the volume are the descriptions of the glaciers, glacier lakes, and glacier meadows in the Californian mountains, and the interesting account of the grand forest-trees of the Sierra.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Origin of Classes among the "Parasol" Ants.

MR. J. H. HART is Superintendent of the Royal Botanic Gardens in Trinidad. He has sent me a copy of his report presented to the Legislative Council in March 1893, and has drawn my attention to certain facts contained in it concerning the "Parasol" ants—the leaf-cutting ants which feed on the fungi developed in masses of the cut leaves carried to their nests. Both Mr. Bates and Mr. Belt described these ants; but described, it seems, different, though nearly allied, species, the habits of which are partially unlike. As they are garden-pests, Mr. Hart was led to examine into the development and social arrangements of these ants; establishing, to that end, artificial nests, after the manner adopted by Sir John Lubbock. Several of the facts set down have an important bearing on a question now under discussion. The following extracts, in which they are named, I abridge by omitting passages not relevant to the issue:—

"The history of my nests is as follows: Numbers one and two were both taken (August 9) on the same day, while destroying nests in the Gardens, and were portions of separate nests but of the same species. No. 3 was procured on September 5, and is evidently a different although an allied species to Nos. 1 and 2.

"Finding neither of my nests had a queen, I procured one from another nest about to be destroyed, and placed it with No. 1 nest. It was received by the workers, and at once attended by a numerous retinue in royal style. On August 30 I removed the queen from No. 1 and placed it with No. 2, when it was again received in a most loyal manner. . . .

"Ants taken from Nos. 1 and 2 and placed with No. 3 were immediately destroyed by the latter, and even the soldiers of No. 3, as well as workers or nurses, were destroyed when placed with Nos. 1 and 2.

"In nest No. 2, from which I removed the queen on August 30, there are now in the pupa stage several queens and several

males. The forms of ant in nests Nos. 1 and 2 are as follows: (*a*) queen (*b*) male (both winged, but the queen loses its wings after marital flight), (*c*) large workers, (*d*) small workers, and (*e*) nurses. In nest No. 3 I have not yet seen the queen or male, but it possesses—(*a*) soldier, (*b*) larger workers, (*c*) smaller workers, and (*d*) nurses; but these are different in form to those of nests No. 1 and No. 2. Probably we might add a third form of worker, as there are several sizes in the nest. . . .

"It is curious that in No. 1 nest, from which the queen was removed on August 30, new queens and males are now being developed, while in No. 2 nest, where the queen is at present, nothing but workers have been brought out, and if a queen larva or pupa is placed there it is at once destroyed, while worker larvæ or pupæ are amicably received. In No. 3 all the eggs, larvæ, and pupæ collected with the nest have been hatched, and no eggs have since made their appearance to date. There is no queen with this nest. . . . On November 14 I attempted to prove by experiment how small a number of 'parasol' ants it required to form a new colony. I placed two dozen of ants (one dozen workers and one dozen nurses) in two separate nests, No. 4 and No. 5. With No. 4 I placed a few larvæ with a few rose petals for them to manipulate. With No. 5 I gave a small piece of nest covered with mycelium. On the 16th these nests were destroyed by small foraging ants, known as the 'sugar' or 'meat' ant, and I had to remove them and replace with a new colony. My notes on these are not sufficiently lengthy to be of much importance. But I noted four eggs laid on the 16th, or two days after being placed in their new quarters; no queen being present. The experiment is being continued. I may mention that in No. 4 nest, in which no fungus was present, the larvæ of all sizes appeared to change into the pupæ stage at once for want of food [a fact corresponding with the fact I have named as observed by myself sixty years ago in the case of wasp larvæ]. The circumstance tends to show that the development of the insect is influenced entirely by the feeding it gets in the larvæ stage.

"In nest No. 2 before the introduction of a queen there were no eggs or larvæ. The first worker was hatched on October 27, or fifty-seven days afterwards, and a continual succession has since been maintained, but as yet (November 19) no males or queens have made their appearance."

In a letter accompanying the report, Mr. Hart says:—

"Since these were published, my notes go to prove that ants can practically manufacture at will; male, female, soldier, worker, or nurse. Some of the workers are capable of laying eggs, and from these can be produced all the various forms as well as from a queen's egg.

"There does not, however, appear to be any difference in the character of the food; as I cannot find that the larger larvæ are fed with anything different to that given to the smaller."

These results were obtained before the recent discussion of the question commenced, and as they agree with the results reached by Grassi in the case of the *Termites*, it can now scarcely be doubted that the various forms or classes among the social insects are wholly determined by the treatment of the larvæ.

St. Leonards, December 2. HERBERT SPENCER.

"Acquired Characters."

I DO not think we are in any way bound by the terms of the law enunciated by Lamarck. Those laws may be shown to be erroneous in all but the suggestion of a principle which may possibly be developed into an important and far-reaching doctrine, and if so the importance of the doctrine will be in nowise diminished by the crudity of the early suggestion. There is scarcely any scientific generalisation which does not require an amended enunciation in each generation if it is to be in accordance with the contemporary state of knowledge. Nevertheless it seems to me that the second law of Lamarck does not state that a character acquired by individuals *for the first time* is inherited, or "alters the potential character of the species." The law states that nature preserves by generation what has been acquired by individuals by the influence of the circumstances to which *their race* has been long exposed: *not* by the influence of the circumstances to which they alone have been exposed in their own individual existences.

Leaving Lamarck's laws and doctrines entirely out of the question, if we define an acquired character as one which is determined by the "operation on the individual of given and related quantities of external agencies," I am not aware that anyone has ever asserted that such a character is inherited, in the sense of being completely reproduced in the offspring without the operation of those external agencies. But I think there is reason to believe that if the same quantity of external agency acts on successive generations, it will produce more effect on the second than on the first, or, to use more correct language, that the effect in the second generation will be increased by a potentiality derived from the first. It is argued that the very possibility of the acquisition of new characters by the individual under new conditions is a proof that the old character had not become fixed and congenital after the action of the old condition on thousands of successive generations. But this is an illustration of the difficulty of completely expressing the problem in abstract language without reference to particular cases. If we consider the case of the pigmentation of the skin of the flounder, we find experimentally that exposure to light of the lower side for some years produces some pigmentation, but not so much as that on the upper side exposed in the individual for the same time. The action on the two sides in the individual being thus equal, or even greater on the lower side, how are we to account for the difference in favour of the upper? Evidently the congenital potentiality of the two sides is different. The old character has then become fixed and congenital to a certain very important degree. If no effect were produced by the action of light on the lower side of the individual, there would be no evidence that the congenital difference in the two sides had been produced by the difference in the relation to light repeated in countless successive generations. On the other hand, if the equal exposure of both sides produced equal pigmentation in the same time, this would be evidence that the difference in the pigmentation under normal conditions was not a congenital character at all. But as the facts stand, the only conclusion which is in accordance with them is that the congenital difference between the two sides is due to the gradual accumulation of slight effects on the congenital potentiality of the germ consequent upon the action of light in the individual. I could mention many other similar instances, which I think do constitute a reason for "associating the somewhat superficial and late responses of the parts of a growing individual to normal or abnormal forces of its environment with that more subtle and profound disturbance which is permanent and affects the potential character of the germ."

I am far, however, from supposing that all specific, generic, or morphological characters are due to the direct action of the environment in the soma, and equally far from admitting that every one of these characters has a part to play in the struggle for existence. J. T. CUNNINGHAM.

Plymouth, November 30.

THE distinction between the "acquired characters" of Lamarck and the other "responsive characters" which follow the "influence of the normal environment" is, I venture to think, not very important. The two kinds of characters are indeed admitted by Prof. Lankester to be "of the same order," and their essential unity is clearly shown when we attempt to trace the history of evolution as Lamarck conceived it.

The *first* increase in length of the neck of the giraffe or swan was no doubt, according to Lamarck, "an acquisition under *new* conditions of *new* character." But when the process had started, its subsequent stages could hardly be spoken of in this way. The effort of stretching, which was supposed to supply the condition for further increase, was then neither "new" nor "special and abnormal."

In the numerous discussions of the last seven years the term "acquired" has been employed to cover both classes of characters, and, indeed, the argument has chiefly turned on the effect of normal rather than abnormal and special conditions, because the evidence supplied by the former for or against hereditary transmission was so much more convincing than that supplied by the latter.

Although the term "acquired" is an unfortunate one, and has added many difficulties and obscurities which would have been avoided by the substitution of Prof. Lankester's term, "responsive," I think it would only increase the difficulties if it were now authoritatively maintained that, although the majority of instances discussed and the really crucial cases adduced are "of the same order" as acquired characters, they must no longer be called by this name.

I entirely agree with Prof. Lankester as to the mutual anta-

gonism between the two laws of Lamarck. The first law assumes that a past history of indefinite duration is powerless to create a bias by which the present can be controlled; while the second assumes that the brief history of the present can readily raise a bias to control the future. EDWARD B. POULTON.

Oxford, December 2.

The Homing of Limpets.

IN NATURE, vol. xxxi. p. 200, Prof. Ainsworth Davis describes some observations he had made on the habits of the limpet. Marked individuals were found to return from their excursions, extending to a distance of some three feet, and to settle down on the spot which is their permanent home. By excision of the tentacles in two individuals Prof. Davis was led to conclude that it is not by these organs that the limpet finds its way back to its own particular scar. "The sense of smell then suggested itself, and it occurred to me," writes Prof. Davis, "that one reason why limpets kept on their scars when covered by the water was to prevent the scent being washed off. With a view to determine this, the space between a wandering limpet and its scar and the scar was carefully washed again and again with sea-water. In spite of this, the limpet in question readily found its way back again."

Last summer I had some opportunities of making observations at Mewps Bay, near Lulworth, in Dorsetshire. I trust that Prof. Davis will not consider a brief record of the results of these observations a case of unsportsmanlike poaching on his preserves.

The method I adopted was to remove the limpets from the rock and affix them at various distances from their scars. This can be done without difficulty or injury if one catches them as they are moving. But one must make sure that they are just leaving or returning to their own proper homes, and are not taken in the midst of a more extended peregrination, as in that case their special scars cannot be noted. Failure to be careful in this matter vitiated my earlier observations, which are therefore excluded in the following table:—

No. removed.	Distance in inches.	No. returned. In 2 tides.	In 4 tides.	Later.
25	6	21	—	—
21	12	13	5	—
21	18	10	6	2
36	24	1	1	3

From the nature of the strata the removal to a distance of 12 inches or more generally involved taking the limpets over a corner of rock.

In most cases the individuals which failed to return to their respective scars took up new positions. In several cases when they were removed to a distance of a few inches from this new position they returned to it. In one case where the limpet had taken up such a new position it returned thereto after having been removed to its original scar.

Observation of the limpets without such experimental removal shows that they make their excursions in search of food chiefly as the tide leaves them and when it is returning. They generally seem to get back to the scar before the tide has well covered it. I have watched them return over considerable distances. In one case ten inches, over a somewhat curved course, was covered in a little under twenty minutes. In another case the limpet on its return journey had to pass between two other limpets, which necessitated the lifting of the shell to some height so as to pass over one of these. On reaching their scar they twist and turn about so as to fit down. When they come wrong way round they rotate pretty rapidly through the 180° to get into position. The final position on the scar is a constant one. One was observed to make a short excursion from and to return to its scar under stillish water. As a rule they seem to remain fixed under water.

The greatest distance I have watched a limpet reach from its scar was 22 inches. But I have found limpets at a distance of 3 feet from their scars—that is to say, from scars on to which they fitted perfectly. This was on a large flat surface.

When they move, the tentacles are projected out beyond the shell, and keep on touching and slightly adhering to the rock. On reaching the scar they carefully feel round it with the tentacles. I am disposed to question the results of Prof. Davis's experiments on the removal of the tentacles. But further observations and experiments are needed to settle the point. I understand that Prof. Davis is now at work upon the subject.

An injury to the edge of the shell seems to be repaired with whitish shell-material in the course of about ten days. And when a new position is taken up to which the shape of the shell is not suited, there appears to be a tendency for the shell to accommodate itself to the uneven surface of new growth along the edges. But this again is a matter on which further observation and experiment are required.

C. LLOYD MORGAN.

Gravitation.

THE nature of my suggestion (*vide* NATURE November 15, p. 57) is simply this:—A phenomenon of adhesion between solids immersed in a tensile liquid presents itself. The explanation offered (as I understand it) suggests that whether the bodies are attracted at long or short distances, will be a question entirely of the extension in the stressed medium of the modified layer. If this explanation be a correct one, or if any explanation involving a reaction between a modified layer (whether condensed or rarefied) and a *tensile* liquid will account for the phenomenon, then I say the experiment is a suggestive one as regards gravitation.

How far the modified layer will extend depends upon the law according to which the stress is distributed in the medium. In the case of matter acting upon matter at molecular distances we have reason to believe that the decrement of the stress is a rapid one. We possess no such knowledge when matter and ether alone are involved, and until we know how a modification of the ether around matter would display itself to our observation, I do not think the possibility of a remotely extended modification can be denied. Gravitation might be the sole resultant phenomenon affecting our senses. J. JOLY.

Trinity College, Dublin.

The Ratio of the Specific Heats of Gases.

I REMEMBER that in the discussion of eighteen years ago it was understood that you could get 1·4 for the ratio, if the molecules had each five degrees of freedom only—if they were, for instance, perfectly smooth, elastic spheroids. Probably the ultimate source of our knowledge in this respect was Boltzmann's paper, to which Mr. Bryan refers us. The difficulty at the time seemed to be mainly one of faith. One could not believe that the molecules were solid elastic bodies, however useful the discussion of such bodies might be in defining a limiting case. As the white posts along a road are put to show you where you should not go, not where you should go. It was further supposed, perhaps without sufficient reason, that the phenomena of the spectroscope required us to attribute many degrees of freedom to the molecules.

I hope Mr. Bryan will, as I have no doubt he can, develop his theory that all these phenomena can be accounted for by the electromagnetic theory of light, without attributing to the molecules more than five degrees of freedom. We have to explain, as it seems to me, how the ether will assume different sets of vibrations according to the shape of the bodies in contact with it. S. H. BURBURY.

1 New Square, Lincoln's Inn.

An Observation on Moths.

I THINK Dr. L. C. Jones (No. 1308, p. 79) has missed the true reason of the unexpanding wings of his moths liberated from the pupa-case before the struggles of the inmate had split the skin, and freed them in the ordinary course.

What was missing to them was the pressure in the act of emergence, which at one and the same time expels a discharge of superfluous humours from the abdomen, and forces the vital fluids through the folded and crumpled wings. Special extra provision is made for this, in the flask-shaped cocoons of *Saturnia Pavonia-minor*, for example, and if the pupa be taken out of this, and allowed to emerge at full maturity, it is always an abortion with heavy, overloaded abdomen, and wings that never expand. Every collector, also, who has bred the earth-burying sphinxes—*Sphinx Ligustri*, for example—knows how often they emerge in this condition, either through not being supplied with soil of the needful tenacity, or from the difficulty of keeping it of the natural degree of moisture.

It would be rash to assume that the struggles of parturition have no analogous bearing on the after vigour and welfare of offspring in the mammalid also. HENRY CECIL.

Bregner, Bournemouth, November 27.

Snakes "Playing 'Possum."

IN connection with Dr. L. C. Jones' account last week of the Puffing Adder that feigned death, it may be of interest to note that on several occasions I have observed similar behaviour on the part of the English grass-snake (*Coluber natrix*). On finding escape impossible the animal would roll slightly over, with its mouth open to its widest extent, and its tongue protruded, and remain perfectly limp and flaccid, allowing itself to be stroked, moved, and even carried in the hand with the head and tail dangling down on opposite sides, without showing any signs of animation. So sudden is the change from activity to quiescence, and so admirable the imitation of lifelessness that it presents, that on the first occasion on which I witnessed it (now many years ago), I believed the snake to have been seized by some species of fit, and to be at the point of death until, in the faint hope of alleviating its seemingly desperate condition, I plunged it into some cold water, with the happy result of effecting its immediate restoration, the snake possibly thinking its ruse had been successful, and it was once more free. I have known cases, however, in which the symptoms have persisted after the application of the cold-water cure. Subsequently I discovered that no treatment of any kind was necessary, as the snake would "come to" of its own accord after a while.

A point which I should be very interested to learn is whether this condition is produced voluntarily by the animal for protective purposes, "the same with intent to deceive," or is the result of a general nervous inhibition, produced reflexly by the action of fright, which would render it more or less analogous to a fainting-fit. G. E. HADOW.

VOLCANIC STALACTITES.

A CURIOUS formation is described by Mr. E. Goldsmith in the *Proceedings* of the Philadelphia Academy of Natural Sciences (part i. 1894, p. 107). It is well known that the highly heated and very fluid lava in the Kilauea crater at Hawaii, as well as in other craters, is occasionally shot up into the air some thirty feet or more. This lava in its descent through the air becomes very porous. If such a highly porous rock have a space underneath, a fresh deposit of liquid lava will trickle through the porous cooled lava, forming as it solidifies the pendant stalactites shown in the accompanying picture, which illustrates Mr. Goldsmith's paper, and has been kindly sent to us by the Academy. The figure represents the entrance to a volcanic cave, photographed by Profs. Sharp and Libbey. It shows an overhanging roof of porous basalt, from which are suspended irregularly gnarled rods of volcanic stalactites; on the floor are scattered fantastic-shaped volcanic stalagmites, which seem to be much thicker than the pendant rods above. Mr. Goldsmith says that the stalactites are about one-fourth of an inch thick, and about eight inches long. They show no disposition to form cones like those seen in limestone caves. They are mostly hollow and porous, and very brittle. The colour is usually a deep black, but sometimes a part is of a brownish tint, due, Mr. Goldsmith thinks, to a higher oxidation of the magnetite present. Fragments of the stalactites, when microscopically examined, exhibited a glassy felspar having apparently the characteristic of sanidine. Magnetite occurred in great profusion, and also gases, probably air. Augite was suspected, but not definitely determined. The specific gravity of a coarse

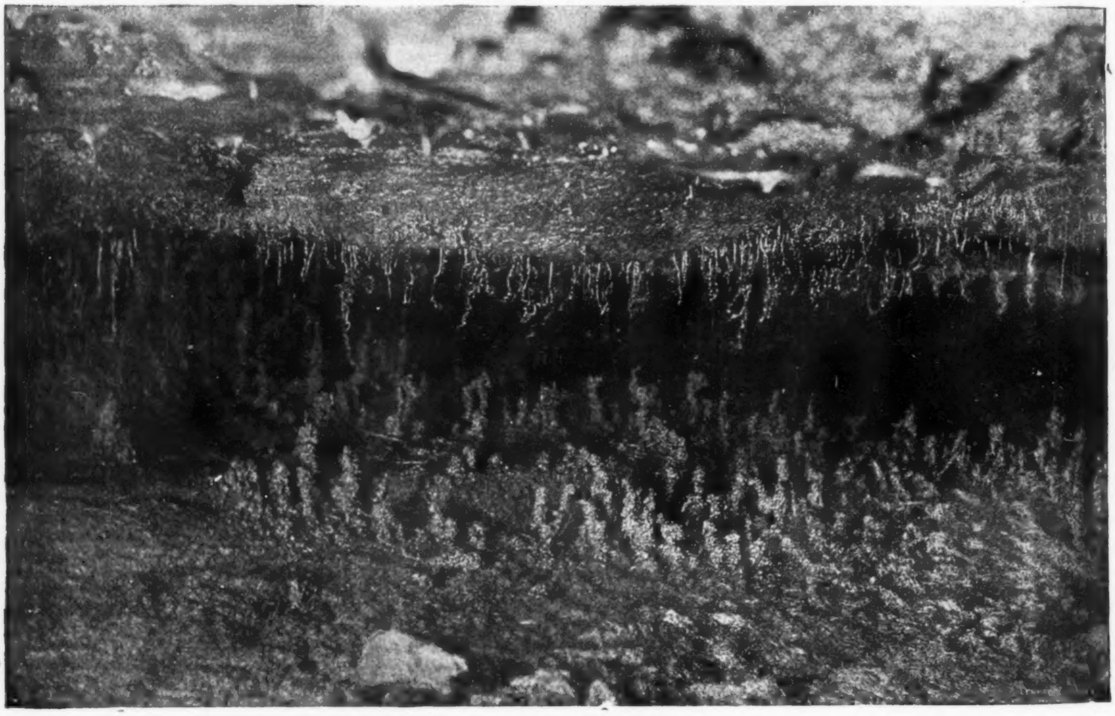

FIG. 1.—Volcanic Stalactites and Stalagmites.

powder produced from the stalactites was found to be 2·85. The lava is decidedly basic, as the quantity of silica determined analytically was 48·55 per cent. On some of the stalactites a thin layer of colourless crystals were recognised under the microscope. An examination of these incrusting crystals proved them to be selenite.

NOTES.

WE are pleased to note that the Court of the Salters' Company have placed at the disposal of the City and Guilds of London Institute a grant of £150 a year, for founding one or more Fellowships for the encouragement of higher research in chemistry in its relation to manufactures. The Fellowships will be awarded by the Executive Committee of the Institute, and the amount of the grant attached to each will be determined by the Committee, with reference to the nature of the research, the time required to complete it, and the merits of the candidate. The Executive Committee will each year apply the sum provided by the Salters' Company to the award of Fellowships to British-born subjects, of a value not exceeding £150 (*a*) to students of the Institute who have completed a full three-years' course of instruction in the chemical department of the Central Technical College, or (*b*) to candidates duly qualified in the methods of chemical research in its relation to manufactures, without restriction as to age or place of previous study. A Fellowship may be renewed for a second and third year, but cannot be held by anyone for more than three years. The holders of the Fellowships will be required to devote their whole time to the prosecution of research, unless otherwise sanctioned by the Executive Committee. The researches will be carried out at the Institute's Central Technical College. Applications for Fellowships should be made in writing addressed to the Honorary Secretary of the Institute, Gresham College, Basinghall Street, London, E.C., and should state the nature of the research proposed to be undertaken, and the qualifications of the candidate. The first award will be made early in the new year.

WE notice with deep regret that Sir Charles T. Newton, K.C.B., the eminent archæologist, died on November 28.

COMMUNICATION by telephone between Vienna and Berlin has just been opened. The length of the line is 410 miles.

DR. S. NAWASCHIN has been appointed Professor of Botany and Director of the Botanic Garden at the University of Kiew; and Dr. K. Schilbersky Professor of Botany and Vegetable Pathology at the Hungarian Agricultural Institute, Buda-Pesth.

THE editorship of the *Jahrbücher für wissenschaftliche Botanik*, vacant by the death of Dr. Pringsheim, has been accepted by Prof. Pfeffer, of Leipzig, and Prof. Strasburger, of Bonn. All communications should be addressed to the former of these. The *Jahrbücher* have been edited by Dr. Pringsheim since their commencement in 1857, and contain many important contributions to structural and physiological botany.

DR. PHILIP LENARD, who was the late Prof. Hertz's assistant and *privat-docent* at the University of Bonn, has recently been appointed Extraordinary Professor of Physics in the University of Breslau. He has published a number of important investigations on cathode rays, phosphorescence, electrification of water-drops, and kindred subjects.

THE Council of the British Institute of Public Health, realising the great and general interest which is at the present time taken in the question of the anti-toxic serum treatment of diphtheria, have made arrangements for a lecture to be given in the Examination Hall of the Royal Colleges of Physicians and Surgeons, Victoria Embankment, on Friday, December 7, at 5 p.m. by Dr. G. Sims Woodhead, entitled "The Diagnosis and Anti-toxic Treatment of Diphtheria."

THE second series of lectures given by the Sunday Lecture Society begins on Sunday afternoon, December 9, in St. George's Hall, Langham Place, at 4 p.m., when Mr. E. Neville Rolfe will lecture on "The Buried Cities of Campania." Lectures will be subsequently given by Mr. Wyke Bayliss, Prof. Marshall Ward, F.R.S., Prof. Vivian B. Lewes, Mr. Oswald Brown, Mr. Arthur Clayden, and Mr. Jas. Craven.

THE following lecture arrangements have been made at the Royal Institution: Prof. J. A. Fleming, F.R.S., six lectures (adapted to a juvenile auditory) on the work of an electric current; Prof. Charles Stewart, twelve lectures on the internal framework of plants and animals; Mr. L. Fletcher, F.R.S., three lectures on meteorites; Dr. E. B. Tylor, F.R.S., two lectures on animism; Lord Rayleigh will also deliver six lectures. The Friday evening meetings will commence on January 18, when Prof. Dewar will deliver a discourse on phosphorescence and photographic action at the temperature of boiling liquid air. Succeeding discourses will probably be given by Sir Colin Scott-Moncrieff, Dr. G. Sims Woodhead, Mr. Clinton T. Dent, Prof. A. Schuster, Prof. A. W. Rücker, Prof. Roberts-Austen, Prof. H. E, Armstrong, and Lord Rayleigh, among others.

DR. PATTERSON, in a lecture before the Piscatorial Society, at the Holborn Restaurant this week, entitled "Salmon, Sea-trout, and Trout—What are they?" maintained that they were all varieties of one species, varying according to their environments. On the same evening an exhibition of this year's specimen fish was held by this Society in their museum at the Holborn.

AT a meeting held at the Borough Road Polytechnic, on November 23, a London branch of the Conchological Society of Great Britain and Ireland was formed. It is thought that such a branch, with monthly meetings for discussion, for exhibition, and for exchange, cannot fail to be of advantage. The branch will in no way be a rival of the Malacological Society, but probably a feeder to it. The first ordinary meeting will be held on Thursday, January 10, 1895, at 7 p.m., in a room lent by the Governors of the Borough Road Polytechnic. The attendance of any conchologists in or near London will be welcomed at this meeting.

DURING the past few years the American Museum of Natural History, situated in Central Park, New York City, has grown very considerably. It suffers from the common complaint, however, of not having sufficient funds to devote to the enlargement of the collections, and this in a city where millionaires most do congregate. The report of the operations of the Institution last year shows that the opening of the museum on Sundays is greatly appreciated. Many important additions have been made to the various collections, the most noteworthy accessions being in the department of mammalian palæontology. Although only in the third year of its establishment, the collections in this department already equal in importance those secured by other institutions through many years of effort. The intention is to form a great collection to represent the evolution of the mammals of North America. Thus far the expeditions to the Rocky Mountain region have secured nearly one thousand five hundred specimens. Fifteen perfect skulls have been obtained from the Bridger Basin, Wyoming. The remains of monkeys, horses, tapirs, primitive rhinoceroses and rodents have also been obtained by the explorations under Dr. J. L. Wortman, and many of them are in an excellent state of preservation. The most notable specimen in the collection is a complete

skeleton of a large Carnivore of the size of a tiger, and is said to be the most perfect specimen of the kind ever found. The total number of volumes in the library now exceeds twenty-eight thousand. We sincerely hope that the citizens of New York will see that the usefulness of the Institution is not limited by the lack of means to acquire new and important material, and to provide proper accommodation for it. They must surely recognise that, even from a commercial point of view, the museum is of the highest value.

IN connection with our note last week, on the wreck of the *Falcon*, the steamer of the Peary expedition, and the loss of all on board, it ought to have been stated that the vessel, after landing the returning members of Mr. Peary's party, had sailed from St. John's with a cargo of coal, and that none of the exploring party, whose charter of the vessel terminated on their landing, were on board.

IN the *Geographical Journal* for December, Captain Mockler Ferryman describes and illustrates the glacier lake known as the Dæmme Vand, near the Hardanger Fiord, in Norway. The Rembesdal glacier at the head of the Simodal, stretches across and dams up a lateral valley in which the lake in question is formed. When during summer the ice-barrier gives way, as it occasionally does, floods of the most disastrous kind are produced in the Simodal. The Norwegian Government has determined to construct a tunnel through the rocks at the mouth of the lateral valley, through which the surplus water of the Dæmme Vand may be harmlessly drained when the level rises to a dangerous height.

CHEMICAL laboratories can now dispense with the wasteful and unpleasant installation for generating sulphuretted hydrogen, for we learn from *Industries and Iron* that liquid sulphuretted hydrogen is commercially obtainable. Although this gas is easily liquefied, the difficulties of manufacture in large quantities at an economic rate have prevented its introduction as a laboratory reagent. Messrs. Baird and Tatlock, who are the sole agents for this commodity, supply the liquid compressed into specially-prepared steel cylinders, each containing one pound of liquid, equal to about eleven cubic feet of gas at atmospheric pressure. Larger cylinders can also be had. In this compressed form, the gas has the advantage of being cleanly and always ready for use, and in those laboratories in which it is only occasionally required as a reagent, a cylinder ought to be included in the laboratory stock. Our contemporary announces that the same firm is about to place liquid chlorine and ethylene on the market.

FOR collections of Coleopterous, Lepidopterous and other insects, the nature of the pin for fastening the specimens is a question of great importance. Ordinary pins of brass, even though well tinned, frequently oxidise in the body of the insect, and eventually destroy the specimen. Black varnished pins are almost as bad, for the varnish soon cracks, leaving the metal exposed. Even plated pins do not appear to resist the action of the compounds developed in the body of the insect, though solid silver ones will. Dr. H. G. Knaggs introduced a bronze pin which has found favour among many entomologists; nevertheless, it is far from being a perfect fastener. In the December number of the *Entomologist's Monthly Magazine*, he directs attention to a pin made from a nickel alloy by Messrs. Deyrolle, of Paris. This pin possesses great advantages over those generally used, and of which the metal basis is brass. It will probably be widely used by collectors, for its price need only be a little higher than that of an ordinary pin.

THAT the efficiency of acoustic fog-signals for purposes of navigation is as yet very doubtful, may be seen from a discussion appearing in *Hansa*. There are many peculiarities in the behaviour of sound, propagated over the surface of the sea from the coast, which require further scientific investigation. Mr. Arnold B. Johnson, author of "The Modern Lighthouse Service," gives it as a general rule, that in proceeding from the neighbourhood of the fog-signal apparatus out into the sea for about two miles a zone is entered in which the signal becomes inaudible. This zone has a width varying from one mile to a mile and a half. That this phenomenon is not confined to coast stations is evident from the fact that it was observed in the case of a station situated on a rock twenty miles from the nearest land. Several such zones are often produced when a steep cliff lies at the back of the signal station. The observations made on the coast of New England are fully borne out by those made at the mouths of the Elbe and Weser. Among the pilots of the German coast it is well known that the sound rockets fired on Heligoland are heard at distances sometimes exceeding twenty miles, become inaudible on approaching the island, and reappear in the immediate neighbourhood of the island. An altogether unexplained and apparently undiscussed phenomenon is that noticed in a specially marked manner in the fog-horn of the Weser lightship. When the sound commences it appears to proceed from a direction entirely different from that in which it dies away.

A SERIES of *Bulletins* of the Madras Government Museum has been commenced by the superintendent, Mr. Edgar Thurston; and parts i. and ii., which have reached this country, contain much useful information upon the fisheries and marine zoology of the Presidency. Part i. contains a revised account of the superintendent's "Notes on the Pearl and Chank Fisheries of the Gulf of Manaar," and its subject matter is already known in great part to British students of "applied zoology." Part. ii., entitled "Note on Tours along the Malabar Coast," records a number of interesting observations in marine zoology made on the west coast of Madras. It is instructive to note that even there the natives have their fishery question. It is stated that formerly the sardines of the coast always arrived regularly, and remained throughout the season; and the fishermen's belief is that they are at the present day frightened away by the numerous steamers which call at Cochin, and retire in search of a less disturbed spot. In addition to steamboat traffic; noises in boats, ringing church bells, artillery practice, the erection of lighthouses, gutting fish at sea, using fish as manure, burning kelp, and the wickedness of the people, have been charged with being responsible for a falling off of the fish supply; but, as Mr. C. E. Fryer has naively remarked, "of these alleged causes only the last, it is to be feared, has been, and is likely to be, a permanent factor in the case."

WE have received from the Rev. S. Chevalier, the second report of the Shanghai Meteorological Society. This number is entirely devoted to a notice of the typhoons of the year 1893, and a final chapter on the general tracks of the typhoons in the Chinese seas. The discussion of each storm is accompanied by diagrams showing the position of the centre at various dates; several examples reported in the present work show that the bearing of the centre coincides with the direction of the swell of the sea, but further observations on that special point are required. The tracks of the typhoons have been classed (1) according to the times of their occurrence, and (2) according to the countries which they visit. The first month of the typhoon season is May, but the storms are of rare occurrence before July; it is noticeable that they originate in different positions, and take somewhat different routes in different months. From the middle of September the typhoons do not reach Shanghai, but they occur further south for some months later. In dividing them according to localities, Father Chevalier distinguishes three classes, viz. Japan typhoons, China, and Cochin China typhoons.

THE *Report* of the Botanical Exchange Club of the British Isles for 1893, just received, contains a number of useful and interesting notes on critical and rare British species, the general *Rubus, Hieracium*, and *Potamogeton* coming in for a specially large share of attention. It is edited by Mr. Jas. Groves.

THE results of the meteorological observations made at the United States Naval Observatory during 1889, and the magnetic observations made at the same observatory during 1892, have just reached us. It would be to the advantage of science if the observations could be published without such a long delay.

THE twenty-first annual report of the Geological and Natural History Survey of Minnesota has been received. It embraces statements relating to progress in the strictly geological portion of the Survey. Independent reports will be published upon the botanical and zoological departments of the work.

THE December number of the *Geological Magazine* contains an account of the life and work of the late Mr. William Topley, F.R.S., written by Mr. H. B. Woodward, and accompanied by a portrait of the deceased geologist. The memoir is a tribute to a life of unremitting labour in the cause of geology, and an expression of the high regard in which Mr. Topley is held by all who cherish his memory.

THE *Geographical Journal* this month gives prominence to a new feature in the way of short summaries of the most recent and trustworthy literature on parts of the world where public interest is concentrated for the time. The regions dealt with are the Waziri country and Madagascar, and in addition there are two special papers of considerable length on Eastern Asia —one by Mr. A. R. Agassiz, on the commercial resources of Manchuria; the other by Baron von Richthofen, on China, Japan, and Korea.

HITHERTO Brehm's well-known collection of works on natural history, in the Merveilles de la Nature series, published by MM. J. B. Baillière et Fils, Paris, has not comprised a volume on botany. This gap is now, however, to be filled by "Le Monde des Plantes," of which the first part has just appeared. The author of the work is Prof. Paul Constantin. There will be eight fasciculi altogether. When the work is completed its two volumes will run into fifteen hundred pages, and be embellished by two thousand illustrations. Particular attention is paid to the use of plants for food, and in medicine, industries, agriculture, and horticulture. The biological characters are also carefully treated. The work promises to be the best popular botanical work published in France, and therefore fittingly finds a place in Brehm's series on the wonders of nature.

MR. A. S. GHOSH has sent us a slender little pamphlet on "Pedal and Antipedal Triangles," being an attempt to investigate the laws of their evolution. (Calcutta: Patrick Press, 1894.) The primitive triangle is considered as obtained from the pedal triangle, and is called its antipedal triangle; so that what is sometimes called the excentric triangle is the antipedal of the primitive triangle. The whole of the pamphlet, which is a fairly neat piece of work, is merely a solution *in extenso* of a "ten-minute conundrum."

WE have received the *Proceedings* and *Transactions* of the Royal Society of Canada, for the year 1892 (vol. x.). The volume contains six papers in the section of mathematical, physical, and chemical sciences. Among these we notice one on the Mexican type in the crystallisation of the topaz, and another on observations of sun-spots at the McGill College Observatory. The section of geological and biological sciences contains the presidential address on the diffusion and sequence of the Cambrian faunas; and, among others, papers on the artificial propagation of marine food fishes and edible crustaceans, and on the correlation of early cretaceous floras in Canada and the United States.

AT the inaugural meeting of the fourteenth session of the Institution of Junior Engineers, held on November 16, Mr. Alexander Siemens gave some wholesome advice to young engineers and inventors. In the course of his address, he dispelled the fable about the circumstances which led to the invention of the steam engine. According to the popular version, Watt, as a small boy, saw the lid of a tea-kettle move up and down, when the water was boiling, and this suggested to him the construction of the steam engine. As a matter of fact, Watt made himself acquainted with what had been done before (a point altogether ignored in the popular version), and had to work very hard before he brought his invention to a successful issue. His example is typical of the true method of progress, and it may be said generally, that in order to approach a problem with the best prospect of success, it is necessary (1) to define, as accurately as possible, the want that exists, or the particular object that is to be attained; (2) to be well acquainted with the scientific principles which come into play; (3) to know how the want is met, or the object attained in practical life; (4) to find out what proposals have been made by others in the same or in a similar case. A careful attention to these requirements will prevent much disappointment and waste of energy. The records of the Patent Office show that one or more of these conditions is frequently ignored. A large class of inventors do not realise that a knowledge of scientific principles would be an assistance in their efforts; or if they study science at all, they think they can acquire the necessary knowledge by a short study, and without much trouble.

A NOTE concerning the synthesis of the chlorides of carbon C_2Cl_4 and C_2Cl_6, during the preparation of carbon tetrachloride by the chlorination of carbon disulphide at low temperatures, is communicated to the *Berichte* by Prof. Victor Meyer. It is a well-known fact that at a red heat the vapour of carbon tetrachloride is dissociated, a portion of the chlorine being liberated and the two chlorides above mentioned being produced. It now appears that this change occurs to some extent at temperatures but slightly elevated above the ordinary. At the chemical works of Messrs. Müller and Dubois, near Mannheim, carbon tetrachloride is manufactured in large quantities by the chlorination of carbon disulphide at temperatures between 20° and 40°. Each operation is allowed to proceed for several days, and the completion is indicated when the liquid has become deeply coloured owing to the formation of sulphur dichloride, S_2Cl_2. The carbon tetrachloride is then distilled off, leaving the chloride of sulphur behind. Upon rectification of the carbon tetrachloride a quantity of a higher boiling oil is obtained, the nature of which Prof. Meyer has investigated. Upon fractionation it separates into three constituents, carbon tetrachloride CCl_4, the liquid chloride analogous to ethylene C_2Cl_4, and the solid chloride C_2Cl_6, the so-called perchlorethane. Excellent crystals of the latter compound are at once obtained practically pure. That a real synthesis of these two latter compounds occurs during the manufacture of carbon tetrachloride at so low a temperature as 20°–40°, is proved by the fact that the carbon disulphide employed is found to be quite pure, except for a mere trace of dissolved free sulphur. Prof. Meyer considers that the two chlorides are produced in accordance with the equations:

$$2CS_2 + 10Cl = C_2Cl_6 + 2S_2Cl_2,$$
$$2CS_2 + 8Cl = C_2Cl_4 + 2S_2Cl_2.$$

THE atomic weight of bismuth has been re-determined by Prof. Schneider, of Berlin, and the result is remarkable as once more affording exactly a whole number, 208, as the relative weight of

an elementary atom compared with the atom of hydrogen. The relative weight of this particularly heavy atom was determined so long as forty-three years ago by Prof. Schneider, and the value obtained was identical with that which is now afforded. Eight years after Prof. Schneider's first determination, Dumas published the results of a number of atomic weight determinations, among them being that of bismuth, to which he assigned the value 210. From that time, 1859, until 1883, Dumas' value came to be generally accepted, although no doubt his method was by no means so little open to objection as that employed by Prof. Schneider. However, in 1883 Marignac took up the subject, and as the result of determinations carried out with the thoroughness for which he was remarkable, the number 208·16 was obtained, thus substantiating the work of Prof. Schneider. More recently Classen has obtained a higher result, 208·9, by an electrolytic method, and Prof. Schneider has undertaken a further series of determinations with the view of testing certain suggestions of Prof. Classen regarding possibility of error in his former estimations. The method is based upon a comparison of the equivalent relation of metallic bismuth to bismuth trioxide. The final result obtained, if $O = 16$, is 208·05, and the greatest divergence from this number among the whole of the individual values is only 0·21. Prof. Schneider's original work, and likewise that of Marignac, is thus confirmed, and bismuth must now be added to the rapidly growing list of elements whose atomic weights are represented by whole numbers.

THE additions to the Zoological Society's Gardens during the past week include a Sykes's Monkey (*Cercopithecus albigularis*, ♂) from West Africa, presented by Mr. J. H. Prestwich; a Mozambique Monkey (*Cercopithecus pygerythrus*, ♂) from East Africa, presented by Mr. C. O. Gridley; a Leopard (*Felis pardus*) from Southern India, presented by Mr. John Christie; two Spotted Eagle Owls (*Bubo maculosa*) from South Africa, presented by Mr. R. A. Langford; an Antipodes Island Parrakeet (*Cyanorhamphus unicolor*) from Antipodes Island, seven South Island Thrushes (*Turnagra crassirostris*) from South Island, New Zealand, presented by Sir Walter L. Buller; two Canary Finches (*Serinus canarius*), four —— Frogs (*Rana*, sp. inc.) from Madeira, four Dwarf Chameleons, (*Chamæleon pumilus*) from South Africa, presented by Mr. H. Bendelack; a Rhomb-marked Snake (*Psammophylax rhombeatus*) from South Africa, presented by Mr. J. E. Matcham; an Arctic Fox (*Canis lagopus*) from the Arctic Regions, deposited; four Nutcrackers (*Nucifraga caryocactes*), European, purchased; sixteen Deadly Snakes (*Trigonocephalus atrox*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE NEW COMET.—The comet of which the discovery was announced in the last number of NATURE is likely to prove a very interesting object. A communication from Prof. Krueger informs us that Dr. Berberich, who is probably in possession of ephemerides of the lost comets depending on various dates of perihelion passage, has noticed the coincidence in the position of this comet at the first observation with that which De Vico's comet of 1844 can assume. It will be remembered that it was this same astronomer who conjectured from somewhat similar grounds the identity of Holmes' comet with that of Biela. But the conjecture in this case seems to be better founded, for elements computed by Dr. Leuschner show a decided similarity with those of De Vico, as computed by the late Dr. Brunnow from the 1844 observations. Seeing that the comet has undergone some fifty years' perturbations since that time, and that the present elements are founded on the observations of but three consecutive days, and can only be considered as roughly approximate, we must be prepared for some considerable deviation.

	Leuschner's elements of Swift's comet.		Brunnow's elements of De Vico's comet.
	° ′		° ′
Long. of perihelion ...	291 48	...	342 30
,, nodes ...	43 4	...	63 49
Inclination	3 16	...	2 55
Minimum distance ...	1·4703	...	1·1864

De Vico's comet has not been seen since 1844, though, with a period of approximately five and a half years, nine returns have occurred, and when the perihelia fall in the autumn, the comet is fairly favourable for observation. There is extant, it is true, an observation of a nebula by Goldschmidt in May 1855, which he thought might have reference to the comet, but Brunnow could not reconcile it with the computed path, and it is usually believed that the comet disappeared after observation in 1844. But Le Verrier and Brunnow both thought that the comet of 1678 was identical with that of 1844, and if this be the case it would seem that the comet might be subject to fluctuations of brilliancy, which would explain the fact of its passage through perihelion without notice.

Further, a similarity between the elements of Finlay (1886 VII.) and De Vico has been noticed, and the agreement between those of the present comet and Finlay's is probably more marked than with De Vico. Tisserand's well-known criterion of identity does not favour the supposition that De Vico and Finlay are one and the same comet, since a very considerable perturbative effect would have to be attributed to the action of Mars. It would seem, therefore, more probable that several comets are moving in approximately the same orbits than that we have to do with the actual return of a comet lost for so long a period as De Vico's. But under any circumstances, seeing that the comet is diminishing in brilliancy, it is of the utmost importance to secure observations as early and as long as possible, since upon the accurate determination of the orbit several important questions may finally rest. The following positions are given in the ephemeris received from Kiel:—

1894.	R.A. h. m. s.		Decl. ° ′
Dec. 6	23 2 52	...	−7 50·9
,, 7	23 5 40	...	−7 31·1

THE SPECTRUM OF MARS.—Prof. W. W. Campbell has lately brought together all the observations of the spectrum of Mars, and discussed them in connection with the telluric spectrum and with his own observations made during the past summer. (*Publications of the Astronomical Society of the Pacific*, vol. vi. No. 37.) He concludes as follows:—

(1) The spectra of Mars and the Moon, observed under favourable and identical circumstances, seem to be identical in every respect. The atmospheric and aqueous vapour bands which were observed in both spectra appear to be produced wholly by the elements of the Earth's atmosphere. The observations, therefore, furnish no evidence whatever of a Martian atmosphere containing aqueous vapour.

(2) The observations do not prove that Mars has no atmosphere similar to our own; but they set a superior limit to the extent of such an atmosphere. Sunlight coming to the Earth *via* Mars passes twice either partially or completely through his atmosphere. If an increase of 25 to 50 per cent. in the thickness of our own atmosphere produces an appreciable effect, a possible Martian atmosphere one fourth as extensive as our own ought to be detected by the method employed.

(3) If Mars has an atmosphere of appreciable extent, its absorptive effect should be noticeable especially at the limb of the planet. Prof. Campbell's observations do not show an increased absorption at the limb. This portion of the investigation greatly strengthens the view that Mars has not an extensive atmosphere.

THE ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

THE anniversary meeting of the Royal Society was held in the apartments of the Society at Burlington House on St. Andrew's Day, November 30. The auditors of the Treasurer's accounts having presented their report, the Secretary read the lists of Fellows elected and deceased since the last anniversary meeting. The qualification of the new Fellows on the home list were given in NATURE of May 17 (vol. l. p. 55). The new Fellows

on the foreign list are Henri Ernest Baillon, Henri Poincaré, and Eduard Suess. During the year, the Society lost eighteen Fellows and three Foreign Members.

H.R.H. Louis Phillippe d'Orleans, Count of Paris, September 8, 1894, aged 56.
John Tyndall, December 4, 1893, aged 73.
The Earl of Lovelace, December 29, 1893, aged 89.
Sir Samuel White Baker, December 30, 1893, aged 72.
Arthur Milnes Marshall, December 31, 1893, aged 41.
Pierre J. Van Beneden, January 8, 1894, aged 93.
William Pengelly, March 16, 1894, aged 82.
Lord Hannen, March 29, 1894, aged 73.
Dr. Charles Edouard Brown-Séquard, April 1, 1894, aged 77.
Lord Bowen, April 10, 1894, aged 58.
Brian Houghton Hodgson, May 23, 1894, aged 94.
George John Romanes, May 23, 1894, aged 46.
Lord Coleridge, June 5, 1894, aged 74.
Charles R. Alder Wright, July 25, 1894, aged 50.
Rev. William Bentinck Latham Hawkins, August 31, 1894, aged 83.
Admiral Sir Edward Augustus Inglefield, September 5, 1894, aged 74.
Hermann Ludwig Ferdinand von Helmholtz, September 8, 1894, aged 73.
Jean Charles Galissard de Marignac, September 15, 1894, aged 77.
William Topley, October 2, 1894, aged 53.
Lord Basing, October 22, 1894, aged 68.
Colonel R. Y. Armstrong, November 1, 1894, aged 55.

Lord Kelvin, the President, then delivered the Anniversary Address as follows:—

Science has lost severely during the past year. In the list of Fellows deceased, which I have read to you, you have heard the names of Tyndall, Milnes Marshall, Van Beneden, Pengelly, Brown-Séquard, Romanes, Alder Wright, Helmholtz, Marignac, Topley, all well known to you as having been in their lives zealous and successful scientific investigators, who have largely contributed to the object for which the Royal Society works, "The Increase of Natural Knowledge." Tyndall, full of fire and enthusiasm in solid experimental work advancing the boundaries of science, contributed largely, by his brilliant lectures and books, to make science popular, as it now is in England and America. By the sad death of Milnes Marshall on Scawfell, in Cumberland, on the last day of 1893, we lost a young, able, and enthusiastic worker in zoology. A few months later, we lost the veteran Pengelly, who did so much for geological science, and gave such delightful and valuable lessons to the larger world of not scientific geologists, in what he did in his exploration of Kent's Cavern, Torquay. Romanes, full of zeal, fighting to the end with the most difficult problems that have ever occupied the mind of man, and devoting his health and his wealth to promote not merely philosophical speculation but also the experimental research by which alone philosophy can have a foundation, left us at the early age of forty-six.

A year ago, in my anniversary address, I called your attention to Hertz's experimental demonstration of electric waves, which he found in working out an experimental problem originally proposed by Helmholtz to him when he was engaged in experimental researches in the Physical Institute of Berlin in 1879. An English translation by Jones, of Hertz's book describing his work on electric waves, dedicated "with gratitude" to Helmholtz, was published in England and America in December 1893. On the first day of the new year the disciple died, and within the year the master followed him. Of the whole of Helmholtz's great and splendid work in physiology, physics, and mathematics, I doubt whether any one man may be qualified to speak with the power which knowledge and understanding can give: but we can all appreciate, to some degree, the vast services which he has rendered to biology by the application of his mathematical genius and highly trained capacity for experimental research to physiological investigation.

In his interesting autobiographical sketch he tells us that his early natural inclination was for physics, which he found more attractive than purely geometrical and algebraic studies; but his father could only give him the opportunity of studying physics by his learning medicine to earn a livelihood, and he himself was by no means averse to thus entering on the study of living matter instead of confining himself to the physics of dead matter. I think we may now feel that the world has gained largely by this early necessity for a young man of great genius and power to choose a practical profession.

One early result was his careful examination, while still a student, of the theory of animal heat, and a little later (1847) his great essay, "Ueber die Erhaltung der Kraft," Conservation of Energy as we now call it, communicated to the Society of Berlin on July, 3 1847, of which he said in 1891, "My aim was merely to give a critical investigation and arrangement of the facts for the benefit of physiologists." As a student he had found that Stahl's theory, ascribing to every living body the possession of the property of "The Perpetual Motion" as an essence of its "vital force," was still held by most physiologists." His essay on the "Conservation of Energy," giving strong reasons for rejecting that theory, though looked upon, at first, by many of the physical and philosophical authorities of the time as a fantastic speculation, was enthusiastically welcomed by younger student philosophers, and must soon have convinced the elder men that, whatever may be the real efficiency of vitality, vast and wonderful as it is, it does *not* include the performance of work without drawing upon a source of energy. This conclusion had been virtually foreseen before the end of last century by Rumford and Davy, and had been clearly stated and powerfully supported by Joule and Mayer a few years before Helmholtz found it for himself and successfully persuaded others of its truth.

It is interesting for us now to know that, while thus contributing so effectively to the abandonment of the old doctrine that vital "force" can work without drawing on an external source of energy, Helmholtz was even more effectively concerned in the establishment of a new doctrine which has given a vast extension to the province of life previously perhaps undreamt of, but now universally recognised as thoroughly well established, and supremely important in modern physiology and medicine. On recovering from a typhus fever in the autumn of 1841, at the age of twenty, the last year of his undergraduate course in the Army Medical School of the Friederich Wilhelm's Institute, he spent the accumulations of his income, which free treatment at the hospital during his illness had left him, in the purchase of a microscope, an instrument then but little used in medical education. He began immediately to use it, and made some important observations on the ganglion cells of invertebrates, which, at the suggestion of his master, Johannes Müller, he took as the subject of his inaugural thesis for the doctor's degree, in November 1842, and which was his first published work.[1] With the same microscope, he observed vibrios in putrefying liquids, which he described in his second published paper (1843), "On the Nature of Putrefaction and Fermentation." His distinguished comrade, Schwann, in the laboratory of Johannes Müller, had already shown that vegetable cells are present in fermenting solutions of sugar, and that air, which had been highly heated, was incapable of exciting the fermentation which the access of ordinary atmospheric air was known to produce. Helmholtz found that oxygen, yielded by the decomposition of water in flasks containing small pieces of boiled meat, did not produce putrefaction. Thus the doctrine, held perhaps by all before them, and certainly supported by the great Liebig, that putrefaction and fermentation are purely chemical processes of eremacausis (or slow combustion), produced by oxygen, was thoroughly disproved by the two young investigators. But Helmholtz went farther, and showed almost certainly that the actual presence of a living creature, vibrio, as he called it, bacterium, as we more commonly call it now, is necessary for either fermentation or putrefaction. He proved by experiment that a partition of moist bladder, between the yeast and the fermentable liquid, prevented the entrance of the vibrios which he had observed, *and prevented the fermentation.* It had been reasonably suggested that fermentation or putrefaction might be a purely chemical process produced by a quasi-chemical agent or poison secreted by a living organism; but Helmholtz's observation disproved this supposition almost certainly, because any such chemical substance in solution would pass by diffusion through the bladder, and produce its effect without any direct action of the living creatures. Although Helmholtz himself was characteristically philosophical and conscientious in not claiming, as absolutely proved, what he had only rendered probable, it is certain that this early work of his on putrefaction and fermentation constituted a very long step towards the great generalisa-

[1] Helmholtz's "Wissenschaftliche Abhandlungen," vol. ii. p. 663

tion of Pasteur, adverse to spontaneous generation, and decisive in attributing to living creatures, born from previous living creatures, not only fermentation and putrefaction, but a vast array of the virulent diseases and blights, which had been most destructive to men, and the lower animals and crops and fruits. It is well that Helmholtz himself lived to see the great benefits conferred on mankind by Pasteur's work; and by the annulment of the deadliness of compound fractures and the abolition of hospital gangrene in virtue of Lister's antiseptic treatment; and by the sanitary defences against fevers and blights, realised by many other distinguished men as practical applications of the science which his own typhus fever of 1841 helped so much to create.

Close after his work on this subject and on animal heat, followed investigations on the velocity of transmission along the sensory nerves of the disturbance to which sensation is due, the time which the person perceiving the sensation takes to decide what to do in consequence, and the velocity of transmission of his orders along the motor nerves to the muscles which are to carry out his will. Results of the highest scientific interest and of large practical importance were given in two great papers published in 1850.[1] This was followed a few years later by his "Tonempfindungen," a great work not merely confined to the perception of sound, but including mathematical and experimental investigations on the inanimate external influences concerned in sound, investigation of the anatomical structure of the ear in virtue of which it perceives sound, and applications to the philosophical foundation of the musical art; which holds a unique position in the literature of philosophy, and is certainly a splendid monument to the genius and indomitable working power of its author. Another great work of Helmholtz is his "Physiologische Optik"; who shall say which of the two books is the more important, the more interesting, or the more valuable? Each of them has all these qualities to a wonderfully high degree. Perhaps the most interesting of his experimental investigations in physiological optics was the measurements, by his ophthalmometer, of the curvatures of the several refracting surfaces constituting the lens-system of the eye, from which he ascertained that it is almost altogether by changing the curvature of the front surface of the crystalline lens that the eye is accommodated by its possessor to vision at different distances. His ophthalmoscope, by which for the first time he himself saw and showed to others the retina of the living eye, was a splendid and precious contribution to medicine. By allowing that outlying portion of the brain to be distinctly seen and examined, it has shown the cause of many illnesses which had been regarded as hopelessly obscure; and for diagnosis and guidance of medical treatment, it is now continually used not only by oculists, but by general practitioners.

Constrained as I feel not to overtax your patience, I find it impossible, on the present occasion, to enter upon Helmholtz's researches in mathematics and mathematical physics farther than just to mention his small but exquisite paper on anomalous dispersion, and the grand contribution to hydrodynamics which we have in his "Integrals of the Hydrodynamical Equations which express Vortex Motion."[2]

Since our last anniversary, important questions regarding the conduct of the ordinary meetings and the publication of papers, both in the *Transactions* and *Proceedings* of the Royal Society, have been engaging the attention of the Council, with the assistance of a committee appointed on July 5, 1893. The final report of this committee was submitted to the Council on July 5, 1894, when resolutions were adopted accepting some of its recommendations and deferring the consideration of others until after the recess.

At the request of the Royal Geographical Society, a committee was appointed by the Council of the Royal Society to consider the advisability of asking the Government to undertake an Antarctic expedition. A very important and valuable report on the advantages which such an expedition would bring, both to science and to practical navigation, was presented by this committee to the Council on May 24. The Council, after much careful consideration, resolved to ask the Lords of the Admiralty to grant an interview on the subject with representatives of the Royal Society. This request was assented to: and an interview was accordingly held between the First Lord of the Admiralty and representatives of the Royal Society; but the proposal of an Antarctic expedition was not favourably received.

The Joule Fund Committee submitted its report on December 7, 1893, and the Council, on its recommendation, adopted the following resolutions:—

I. That the regulations for administering the Joule-Memorial Fund be as follows:—

(1) That the proceeds be applied in the form of a studentship or grant, to be awarded every year, to assist research, especially among younger men, in those branches of physical science more immediately connected with Joule's work.

(2) That this grant be international in its character, and awarded alternately in Great Britain and abroad, or in such order as the President and Council shall from time to time decide.

(3) That it be awarded in Great Britain by the President and Council of the Royal Society; and, for award in France, offered to the Académie des Sciences, Paris; and in Germany to the K. Akademie der Wissenschaften, Berlin; or, in any other country, to the leading scientific institution, for award in that country.

(4) That the award in Great Britain be made on the recommendation of a committee, from time to time appointed by the President and Council of the Royal Society, but not of necessity confined to Fellows of the Society.

II. That a sum of £100, which is now, or shortly will be, available, for the first studentship or grant be awarded in accordance with Regulation 4.

The first appointment was accordingly made on June 21, 1894, when it was resolved:—

(1) "That a Joule Scholarship of the Royal Society Memorial Fund be awarded to Mr J. D. Chorlton, of Owens College, Manchester, for the purpose of enabling him to carry on certain researches on lines laid down by Dr. Joule, more especially with the view of determining the constants of some of the instruments employed by Dr. Joule, which can be placed at his disposal by his representatives."

(2) "That the value of the Scholarship be £100, payable quarterly, on the certificate from the authorities of Owens College that the researches are being conducted in a satisfactory manner."

On the occasion of Sir George Buchanan's retirement from the post of Chief Medical Officer to the Local Government Board, it was decided by some of his friends that a testimonial should be presented to him, and a sum, amounting to about £340, has been subscribed by medical officers of health, sanitary engineers, and others interested in sanitary science. It was resolved, on the suggestion of Sir George Buchanan himself, that this testimonial should take the form of a medal, to be awarded periodically for work done in connection with sanitary science, and that the Royal Society should be asked to administer the testimonial fund under the following conditions:—

(1) The money collected, after paying expenses incurred, to be devoted—

(*a*) To the foundation of a Gold Medal of the value as nearly as may be of twenty guineas, with a portrait of Sir George Buchanan on the one side and an appropriate design on the other, to be awarded every three or five years in respect of distinguished services to Hygienic Science or Practice, in the direction either of original research or of professional, administrative, or constructive work.

(*b*) To the bestowal on the recipient of the Medal of the amount (remaining after paying for the Medal and discharging the incidental expenses) which has accumulated since the last award.

(2) The Medal to be awarded without limit of nationality or sex.

The Council of the Royal Society has accepted the trust under these conditions; and it was agreed that the first medal should be given to Lady Buchanan by the testimonialists themselves.

The Catalogue Department has been specially active in the past session. Mr. Ludwig Mond's generous gift of £2000, which I announced to the Society in my anniversary address last year, has given a new impulse to our operations in that department, and enabled us to increase the staff of assistants. Under the able superintendence of Miss Chambers, volume 10

[1] Helmholtz's "Wissenschaftliche Abhandlungen," p. 763 861.

[2] *Philosophical Magazine*. July 1867, being the translation by Tait of the original German paper, which appeared in *Crelle's Journal* in 1858, and which has been republished in "Wissenschaftliche Abhandlungen," vol i. pp. 101 134.

of the Catalogue under authors' names has been completed, and was issued in June of the present year. The Society is indebted to several members of the Catalogue Committee who have lent their scientific knowledge to aid in the revision of the proofs, and especially to the Treasurer, under whose experienced eye every sheet in the catalogue has passed. The preparation of copy for a supplementary volume, which will include papers from a large number of periodicals not included in the existing volumes, is now nearing completion.

The Catalogue Committee have held several meetings and discussed some important questions. The proposed subject-index to the existing catalogue has been the chief matter under consideration, and the burning question of the respective merits of an alphabetical and a classified index has been so far settled as to make it possible to commence the work of transcription and translation, nearly 40,000 slips being already finished, so that when the details of the plan agreed upon have been finally settled, as there is good hope they will be in the near future, the preparation of the copy for the printer can be speedily proceeded with. Before, however, any final steps can be taken, it will be necessary that the supplement volume of the catalogue should have issued from the press. The preparations for this volume are in active progress.

A kindred subject, but one of still wider scope, has been discussed by a special committee appointed by the Council at their first meeting in the present session. The question, namely, of a scientific subject-catalogue, which it is proposed to carry out by means of international co-operation. This committee, with the sanction of the Council, have addressed a circular letter to scientific societies and institutions in this country and abroad, offering by way of preliminary suggestions, first, that the catalogue should commence with the next century; secondly, that a central office or bureau should be maintained by international contributions; and third, that this office should be supplied with all the information necessary for the construction of the catalogue. The circular invites the views on this subject of scientific bodies and scientific men, without in any way committing the Society to farther action. A large number of replies to this circular have been received, many of them carefully prepared and able documents. They will be submitted to the new Council of the Royal Society, and will, I am sure, be most valuable in assisting it to judge as to future proceedings.

The principal question which the Library Committee have had before them during the past session is the accumulation of the stock of *Philosophical Transactions* from the beginning of the century to the present time. New racks have been erected in the basement, which have partly relieved the pressure on our space, but the Committee recognise the necessity of some active measures being taken to increase the sale of this accumulated stock. They are of opinion that the sale might be much facilitated if the memoirs composing the volumes published in the past were made separately available to the public, as is done with those that are published at the present time. On the advice of the committee, the Council have empowered the Treasurer to treat with one of the leading booksellers with the view of bringing some such arrangement into effect.

The collection of marble busts belonging to the Society, which is of such personal and historical interest to all our Fellows, has received a most important and valuable accession. The sons of our former President, Mr. William Spottiswoode—Messrs. Hugh and Cyril Spottiswoode—have presented to the Society a marble bust of their father, by Woolner, which will find in our apartments a fitting home among the busts of many of our former Presidents and distinguished Fellows, and will hand down to posterity a striking likeness of one who deserved so well of the Society and whose premature decease we all still deplore.

The House and Soirée Committee have discussed the advisability of increasing the accommodation in the tea room, and have presented a report to the Council upon the subject. The Council, while not disagreeing with this report, considered it wiser, in the present state of finances, to defer the matter for a time.

A third report of the Water Research Committee has been issued during the present year. It gives the results of further experiments by Prof. Marshall Ward on the "Action of Light on Bacillus Anthracis," and on the "Bacteria of the Thames," and the experiments of Prof. Percy Frankland on the "Behaviour of the Typhoid Bacillus and of the *Bacillus Coli Communis* in Potable Water," the whole filling 242 octavo pages.

Unusually large as was the amount of matter published last year, this year the amount is even larger. In the mathematical and physical section of the *Philosophical Transactions*, seventeen papers have been published, eighteen in the biological section. The two sections together contain, in all, 1992 pages of letterpress, and 112 plates; to which must be added eight or ten papers now passing through the press, and probably to be issued before the close of the year. Of the *Proceedings*, ten numbers have been issued, containing 1026 pages. As a result, the finances of the Society are, I regret to say, in not such a satisfactory condition as could be desired. The cost of the publications, which, last year, was far in excess of what it was in previous years, and of what the Society could really afford, has, in the year 1894, amounted to nearly £3260, or about £90 more than it was in 1893. For lithography and engraving alone £1516 have been paid, as against £977 last year. There is, moreover, an accumulation of printed matter now almost in readiness to be issued, the cost of which has still to be defrayed. To meet this extraordinary expenditure it has been necessary to sell out enough of the Society's funded capital to produce £1000, and rigorous retrenchment will be necessary in order to avoid further loss of provision for continued work in future. While the Council feels the importance of all the publications of the Society being as completely illustrated and as fully detailed as the subjects discussed may require, it is evident that some check must be placed on the extent of the publications, and the best manner of effecting this end is occupying the careful attention of the Council.

The establishment of the Faraday-Davy Research Laboratory, in connection with the Royal Institution, is a splendid benefaction which science has gained during the past year, through the untiring and grand generosity of Mr. Ludwig Mond. The Royal Society interests itself in all work contributing towards the object for which it was founded—the increase of natural knowledge; and while gratefully remembering the assistance so generously given to it in the humble but highly valuable work of cataloguing papers which describe the results of scientific investigations already made, it hails with delight this grand foundation of a practical laboratory, of which the purpose is not the teaching of scientific truths already discovered, but the conquering of fresh provinces from the great region of the unknown in nature.

The greatest scientific event of the past year is, to my mind, undoubtedly the discovery of a new constituent of our atmosphere. If anything could add to the interest which we must all feel in this startling discovery, it is the consideration of the way by which it was found. In his presidential address to Section A of the meeting of the British Association at Southampton in 1882, Lord Rayleigh, after calling attention to Prout's law, according to which the atomic weights of the chemical elements stand in simple relationship to that of hydrogen, said:—"Some chemists have reprobated strongly the importation of *à priori* views into the consideration of the question, and maintain that the only numbers worthy of recognition are the immediate results of experiment. Others, more impressed by the argument that the close approximations to simple numbers cannot be merely fortuitous, and more alive to the inevitable imperfections of our measurements, consider that the experimental evidence against the simple numbers is of a very slender character, balanced, if not outweighed, by the *à priori* argument in favour of simplicity. The subject is eminently one for further experiment; and as it is now engaging the attention of chemists, we may look forward to the settlement of the question by the present generation. The time has, perhaps, come when a redetermination of the densities of the principal gases may be desirable—an undertaking for which I have made made some preparations." The arduous work thus commenced in 1882, has been continued for twelve years,[1] by Rayleigh, with unremitting perseverance. After

1 "On the relative Densities of Hydrogen and Oxygen. Preliminary Notice," by Lord Rayleigh, February 2, 1888. "On the Composition of Water," by Lord Rayleigh, February 26, 1889. "On the relative Densities of Hydrogen and Oxygen. II." By Lord Rayleigh, February 5. 1892. "On the Densities of the principal Gases," by Lord Rayleigh, March 23, 1893. "On an Anomaly encountered in Determinations of the Density of Nitrogen Gas," by Lord Rayleigh, April 19, 1894. All published in the *Proceedings* of the Royal Society.

twelve years of it, a first important part of the object, the determination of the atomic weight of oxygen with all possible accuracy was attained by the comparison,[1] of Scott's determination of the ratio of the volumes of hydrogen and oxygen in the constitution of water, with Rayleigh's determination of the ratio of the densities. The result was 15·82, which is almost 1 per cent. (0·87 per cent.) less than the 16, which it would be according to Prout's law. It is very slightly less (¼ per cent.) than Dittmar and Henderson's value obtained by an investigation[2] for which the Graham medal of the Glasgow Philosophical Society was awarded in 1890. Values, not quite so small as these for the atomic weight of oxygen, had been previously found by Cooke and Richards (15·869) and by Leduc (15·876). There can be no doubt whatever now that the true value is more than ½ per cent. smaller than according to Prout's law, and that in all probability it agrees exceedingly closely with the results obtained by Rayleigh and Scott, and by Dittmar and Henderson. The question of Prout's law being thus so far set at rest, Rayleigh, persevering in the main object which he had promised in 1882, "a redetermination of the densities of the principal gases," attacked nitrogen resolutely and, stimulated by most disturbing and unexpected difficulties in the way of obtaining concordant results for the density of this gas as obtained from different sources, discovered that the gas obtained by taking vapour of water, carbonic acid, and oxygen from common air was denser[3] by 1/230 than nitrogen obtained by chemical processes from nitric oxide or from nitrous oxide, or from ammonium nitrite, thereby rendering it probable that atmospheric air is a mixture of nitrogen, and a small proportion of some unknown and heavier gas. Rayleigh and Ramsay, who happily joined in the work at this stage, have since succeeded in isolating the new gas, both by removing nitrogen from common air by Cavendish's old process of passing electric sparks though it, and taking away the nitrous compounds thus produced by alkaline liquor; and by absorption by metallic magnesium. Thus we have a fresh and most interesting verification of a statement which I took occasion to make in my presidential address to the British Association in 1871,[4] "Accurate and minute measurement seems to the non-scientific imagination a less lofty and dignified work than looking for something new. But nearly all the grandest discoveries of science have been but the rewards of accurate measurement and patient long-continued labour in the minute sifting of numerical results." The investigation of the new gas is now being carried on vigorously, and has already led to the wonderful conclusion that the new gas does not combine with any other chemical substance which has hitherto been presented to it. We all wait with impatience for further results of their work; we wish success to it, and we hope that it will give us, before the next anniversary meeting of the Royal Society, much knowledge of the properties, both physical and chemical, of the hitherto unknown and still anonymous fifth constituent of our atmosphere.

COPLEY MEDAL.

Dr. Edward Frankland, F.R.S.

The Copley Medal is awarded to Dr. E. Frankland for his eminent services to theoretical and applied chemistry.

At a time when the classification of organic compounds in homologous series was a comparative novelty, when isomerism was still a profound mystery, and the theory of compound radicles introduced by Liebig was still on its trial, Dr. Frankland made his first attempt (in 1848) to isolate the radicle of common alcohol. Though the attempt was in one sense unsuccessful, inasmuch as the free radicle was never obtained, for reasons which we now more fully understand, the research led to important consequences. The discovery of the organo-metallic compounds, and the study of their composition and properties, was followed by a recognition of the fact, first that the capacity for combination possessed by the atoms of the metals was limited (*Phil. Trans.*, 1852), and secondly that variation of "atomicity," as it was then called, usually occurs by an even number of units (*Journ. Chem. Soc.*, 1866), represented by atoms of hydrogen, chlorine, or such compound radicles as methyl, ethyl, and the rest. These discoveries form the basis of the modern doctrine of valency, with all the important consequences that follow, including the idea of the orderly linking of atoms, and hence the theories of structure or constitution now current.

The discovery of zinc ethyl placed in the hands of chemists an important new instrument of research, which Dr. Frankland was himself the first to use in his investigations concerning the synthetical production of acids of the lactic and acrylic series. Further important synthetical work, conducted in concert with Mr. Duppa, led to a method of ascending the series of acids homologous with acetic acid.

Dr. Frankland's researches in pure chemistry are almost rivalled in interest by his discoveries in physical chemistry, especially in relation to the influence of pressure on the rate of combustion, on the light emitted during combustion, and on the cause of luminosity in hydrocarbon flames.

The important work done by Dr. Frankland in the study of water supply and sewage, and illuminating gas, has proved of great practical value, and has rendered his name famous in connection with the application of chemistry to technical purposes.

RUMFORD MEDAL.

Professor Dewar.

During more than twenty years past Prof. Dewar has been engaged in researches of great difficulty, in the first instance at very high, and latterly at very low temperatures, his inquiries having extended over an extraordinary wide field, as will be seen by reference to the "Royal Society Catalogue" of scientific papers.

In conjunction with Prof. Liveing, he has communicated to the Royal Society a large number of papers which have added much to our knowledge of spectroscopic phenomena.

During recent years he has made the liquefaction of gases a subject of deepest study, and in the course of this work has displayed not only marvellous manipulative skill and fertility of resource, but also great personal courage, such researches being attended with considerable danger. One of his chief objects has been so to improve and develop the methods of liquefying the more permanent gases that it shall become possible to deal with large quantities of liquid, and to use such liquids as instruments of research in extending our knowledge of the general behaviour of substances at very low temperatures. In this he has already been highly successful. Not only has he succeeded in preparing large quantities of liquid oxygen, but he has been able by the device of vacuum-jacketed vessels to store this liquid under atmospheric pressure during long periods, and thus to use it as a cooling agent. Very valuable outcome of these labours has been the series of determinations, made by him in conjunction with Dr. Fleming, of the electrical conductivity of metals at exceedingly low temperatures, which have furnished results of a most unexpected character, and of extraordinary interest and importance. Prof. Dewar's experiment showing the great magnetic susceptibility of liquid oxygen is exceedingly important and interesting. His recent observations on phosphorescence, and on photography,[1] and on ozone[2] at very low temperatures, have given surprising results of a highly instructive and interesting character. It is difficult to exaggerate the importance of extending these researches, which certainly deserve all possible encouragement and support. The award of the Rumford Medal to Prof. Dewar is made in recognition of the services which he has rendered to science by the work which he has already done and the provision he has been successful in making for future work, in the investigation of properties of matter at lowest temperatures.

ROYAL MEDAL.

Prof. J. J. Thomson, F.R.S.

Prof. J. J. Thomson has distinguished himself in both mathematical and experimental fields of work. His first essay on vortex rings showed power of grappling with difficult problems, and added to our knowledge concerning the encounter of rings which came within a moderate distance of one another so as to deflect each others' paths.

His theoretical work in the borderland of chemistry and physics has been very interesting and suggestive. His experimental work has likewise been mainly on the borders of chemistry and physics. He has observed the large conductivity

[1] Scott, "On the Composition of Water by Volume," communicated by Lord Rayleigh, *Roy. Soc. Proc.*, March 23, 1893.
[2] *Proceedings* of the Philosophical Society of Glasgow, 1890-1891.
[3] "On an Anomally encountered in Determinations of the Density of Nitrogen Gas," *Roy. Soc. Proc.*, April, 1894.
[4] Republished in vol. ii. of "Popular Lectures and Addresses."

[1] *Chem. Soc. Proc.*, June 28, 1894.
[2] *Phil. Mag.*, August 1894, pp. 238, 239.

of many gases and vapours, and proved the non-conducting power of several others, founding on the conducting power of iodine vapour important speculations as to its probable chemical constitution.

He has also measured the specific resistance of various electrolytes, under extremely rapid electric oscillations, by an ingenious and valuable method, based on the partial opacity of semi-conducting matter to electromagnetic waves. Recently he has worked at the discharge of electricity through rarefied gases, getting induced currents in closed circuits in sealed bulbs without electrodes, and, in especial, measuring to a first approximation the absolute velocity of the positive discharge through a long vacuum tube, proving that it was comparable with, though decidedly less than, the velocity of light. He also gave an ingenious theory of the striæ—a theory which he has since endeavoured, with some success, to extend to a large number of electrical phenomena, the whole of electric conduction and induction being regarded by him from the chemical side as a modified or incipient electrolysis, or as concerned with electrolytic chains of molecules or "Faraday tubes."

Some of his recent mathematical work on the theory of electric oscillations in spheres and cylinders, and in dumb-bell oscillators of the kind used by Hertz, with reference to not only their oscillation-frequency but also their damping efficiency, has been of much service to experimental workers in those branches of physics. And, in general, the effective manner in which he attacks any electrical problem presenting itself, as evidenced by his book on "Recent Researches in Electricity and Magnetism," wherein he worthily carries on into a third volume the great treatise begun by Clerk Maxwell, is evidence of consummate ability combined with remarkable energy and power of work.

ROYAL MEDAL.

Prof. Victor Horsley, F.R.S.

A Royal Medal is awarded to Prof. Victor Horsley, F.R.S., for his laborious and fruitful researches in physiology and pathology, and particularly for those relating to the functions of the nervous system and of the thyroid gland. His inquiries relating to the former subject have been pursued for more than ten years, and have been communicated to the Royal Society in a succession of papers, the most important of which have been published in the *Philosophical Transactions*. The first of the series of researches (*Phil. Trans.*, 1888), which was conducted in co-operation with Prof. Schäfer, and concerned the relation of a part of the cerebral cortex (the limbic lobe) to sensation, afforded a new confirmation and extension of the doctrine of the localisation of cerebral function now generally accepted. While this work was in progress, Prof. Horsley engaged with Dr. Beevor in a long and laborious series of experiments for the purpose of determining with the utmost attainable accuracy the nature of the muscular responses which are evoked by stimulating the convolutions in the quadrumana. The results of these researches were communicated in four papers, of which the first three relate to the "cortical representations" of the movement of the limbs, and of those of the tongue and face (*Phil Trans.*, 1887–1890); the fourth on the channels (in the internal capsule) by which the cortex exercises its influence on the rest of the nervous system (*Phil. Trans.*, 1890).

These experiments not only served to bring to light a number of new facts, and to elucidate their physiological relations in a very remarkable way, but had a special interest in their bearing on the physiology and pathology of the brain in man. Their importance in this respect is enhanced by the circumstance that in the course of the inquiry the opportunity offered itself of comparing the brain of the monkey with that of the orang (*Phil. Trans.*, 1890), a brain which so closely approaches that of man in its structure that the knowledge acquired by these researches may now be confidently used as a guide in the diagnosis and treatment of cerebral disease. Prof. Horsley has himself shown—and this is not the least of the merits which it is desired to recognise in the bestowal of the Royal Medal—in how many instances the knowledge which is acquired by patient and skilful work in the laboratory may be made available for the saving of life, or the alleviation of human suffering.

In connection with this leading series of researches, two others relating to the physiology of the central nervous system must be referred to. In one of these (*Phil. Trans.*, 1890), Prof. Horsley (in co-operation with Dr. Semon) established the existence, not only of a co-ordinating centre in the bulb, but of a cortical area in physiological relation with the respiratory and phonatory movements of the larynx; in the other, in conjunction with Prof. Gotch, he investigated the electrical changes in the spinal cord which are associated with excitation of the cortex and internal capsule, and showed how the observation of these facts can be made available for tracing channels of conduction in the cord.

As regards the thyroid gland, Prof. Horsley's inquiries relating to functions of that organ were like those relating to the nervous system, begun ten years ago, though the results were not communicated to the Royal Society until three years later. Their purpose was to ascertain the nature of the very marked influence which the thyroid was known to exercise on the nutritive functions of the organism, and to show that this influence is constant and definite. In this field, Prof. Horsley has not only the merit of having been one of the earliest workers, but of having at this early period arrived at results which the numerous investigations of subsequent writers have in all essential particulars confirmed.

DAVY MEDAL.

Prof. Peter Theodor Cleve.

The Davy Medal is awarded to Peter Theodor Cleve, Professor of Chemistry in the University of Upsala, for his services to chemical science during the last thirty years, and in particular for his long-continued and valuable researches on the chemistry of the rare earths.

This field of inquiry is pre-eminently Scandinavian. By the manner in which he has cultivated it, Prof. Cleve has shown himself a worthy successor of such forerunners as Gadolin, Berzelius, and Mosander, and by sound and patient investigation he has faithfully upheld the traditions inseparably associated with these names. All chemists are agreed that no department of their science demands greater insight or more analytical skill than this particular section. Many of the minerals which furnish the starting-point for investigation are extremely rare, and the amounts of the several earths which they contain are frequently very small. Moreover, the substances themselves are most difficult of isolation, and their characters are so nearly allied that the greatest care and judgment are required in order to determine their individuality.

A remarkable example of Prof. Cleve's power in overcoming these difficulties is seen in his masterly inquiry into the affinities and relations of the element scandium, discovered by Nilson. This, one of the rarest of the metals, is found only in gadolinite to the extent of 0·003 per cent., and in yttrotitanite to the extent of about 0·005 per cent. The whole amount of the material, as oxide, at Cleve's disposal was only about 1 gram, but with this small quantity he determined the atomic weight of the element, and ascertained the characters of its salts with such precision as to leave no doubt of the identity of scandium with the element *Ekabor*, the existence of which was predicted by Mendeléef, in the memorable paper in which he first enunciated the Law of Periodicity. Cleve's research, indeed, constitutes one of the most brilliant proofs of the soundness of the great generalisation which science owes to the Russian chemist.

A not less remarkable instance of Cleve's skill as a worker is seen in his research on samarium and its compounds, which he communicated as one of its Honorary Foreign Fellows to the Chemical Society of London. The existence of samarium was inferred independently by Delafontaine and Lecoq de Boisbaudran, but we owe to Cleve the first comprehensive investigation of its characters and chemical relations. From the nature of its compounds, a large number of which were first prepared and quantitatively analysed by Cleve, and from the value of its atomic weight, which was first definitely established by him, it would appear that samarium most probably fills a gap in the eighth group of Mendeléef's system.

We are further indebted to Cleve for a series of determinations of the atomic weights of the rare substances yttrium, lanthanum, and didymium; these are generally accepted as among the best authenticated values for these particular bodies.

No record of Cleve's scientific activity would be complete without some reference to his investigations in the domain of organic chemistry, and more particularly to his studies, extending over twenty years, of naphthalene derivatives. By these researches, made partly independently, and partly in conjunction with his pupils, among whom may be named Atterberg, Widman, Forsling, and Hellström, Cleve has gradually brought order out of confusion, and has supplied most valuable experimental

evidence of the constitution of naphthalene, and of the course of substitution of naphthalene derivatives. Within recent years a score of workers have occupied themselves with the same field of research, and no greater proof of Cleve's accuracy and care as an investigator could be furnished than the manner in which his naphthalene work—confessedly one of the most intricate and complicated sections of the chemistry of aromatic compounds—has stood the ordeal of revision.

DARWIN MEDAL.

Right Hon. T. H. Huxley, F.R.S.

The Darwin Medal is awarded to Thomas Henry Huxley.

Of Mr. Huxley's general labours in biological and geological science I need say nothing here. They are known of all men, and the Society showed its appreciation of their worth when it awarded to him the Copley Medal in 1888. The present medal is a token of the value put by the Society on the part of his scientific activity bearing more directly on the biological ideas with which the name of Charles Darwin will always be associated.

All the world now knows in part, no one perhaps will ever know in full, how, in the working out of his great idea, Darwin was encouraged, helped, and guided by constant communion with three close and faithful friends, Charles Lyell, the younger Joseph Dalton Hooker, and the still younger Thomas Henry Huxley. Each representing more or less different branches of science, each bringing to bear on the problems in hand more or less different mental characters, all three bore share, and were proud to bear share, in aiding the birth of the "Origin of Species." Charles Lyell has long been removed from amongst our midst. Two years ago it was my pleasing duty to place the Darwin Medal in the hands of Joseph Dalton Hooker; that pleasing duty is renewed to-day in now giving it to the last of the three "who kept the bridge."

To the world at large, perhaps, Mr. Huxley's share in moulding the thesis of "Natural Selection" is less well known than is his bold unwearied exposition and defence of it after it had been made public. And, indeed, a speculative trifler, revelling in problems of the "might have been," would find a congenial theme in the inquiry how soon what we now call "Darwinism" would have met with the acceptance with which it has met, and gained the power which it has gained, had it not been for the brilliant advocacy with which in its early days it was expounded to all classes of men.

That advocacy had one striking mark; while it made or strove to make clear how deep the new view went down and how far it reached, it never shrank from striving to make equally clear the limits beyond which it could not go. In these latter days there is fear lest the view, once new but now familiar, may, through being stretched farther than it will bear, seem to lose some of its real worth. We may well be glad that the advocates of the "Origin of Species by Natural Selection," who once bore down its foes, is still among us ready, if needs be, to "save it from its friends."

The Society next proceeded to elect the officers and Council for the ensuing year. We gave the list of those recommended for election in our issue of November 8.

In the evening the Fellows and their friends dined together at the Whitehall Rooms of the Hôtel Métropole.

After the usual toasts, the President proposed that of "The Medallists," coupling with it the names of Prof. Cleve and Mr. Huxley. The toast was most cordially drunk. The *Times* reports the responses as follows:—

Prof. Cleve, in responding, quoted the noble words of Davy—"Science, like that nature to which it is bound, is neither limited by time nor by space; it belongs to the world, and is of no country and of no age." In the same sense the Royal Society continued to award its medals to men of science, without regard to their nationality. It was a great and elevating thought that there existed a spot in the world where members of all nations met each other as friends, assisting each other in their work for the advancement of science, and therefore for the good of humanity and the prosperity of mankind. It was the first time that the Davy medal had found its way to Sweden, but it was not the first time that other medals of the Royal Society had been voted to Professors of the Vniversity to which he was attached. The Rumford medal had been given not less than three times to his colleagues, and when he offered to the Royal Society his respectful thanks he was happy to include also those of the University of Upsala.

Mr. Huxley said—I am extremely grateful for the respite which has been afforded me by the distinguished foreigner to whom you have just been listening with so much pleasure, because I am loaded with five distinct and separate parcels of gratitude. That is a substance of which I believe the specific gravity has never yet been accurately determined. I am told that in some parts of the world, and especially in the political world, it is lighter than hydrogen; but in the scientific world, and when the object of it is the approbation of a body like the Royal Society, I am disposed to think that we may rank it rather with platinum, so largely does it affect the destinies of those who are fortunate enough to receive it. In respect of four of these parcels I am simply a representative, and perhaps I ought to content myself with acting purely as a representative of those who I wish had been called upon to express their gratitude for themselves. But perhaps I may venture to add that in some cases I have a little personal word to say for myself, as, for example, in that of the Copley medal, which you have adjudged one of my oldest friends and many years a colleague, so that I have a strong and warm interest in the fact that his great services to the science of chemistry have been recognised. And, again, I think that there is another friend in whom I may claim a personal interest—I mean my friend Prof. Dewar—for the remarkable character of his discoveries allows a person who indulges so little in flights of imagination as myself to think of the time when, instead of the excellent liquid with which we have been supplied here, we may have at these dinners of the Royal Society liquid oxygen *bien frappé*, and then, gentlemen, with that stimulus there is no saying to what length the eloquence of persons who address you may go. And then, again, in one of the youngest of those whom you have honoured with your approbation to-day, and whose work lies within the province in which I am still capable if not of knowledge at least of appreciation—I mean Prof. Victor Horsley—I may say that it is pleasant to me to see him here like a Ulysses who has escaped from the toils of the Circes of anti-vivisection. But the most difficult task that remains is that which concerns myself. It is forty-three years ago this day since the Royal Society did me the honour to award me a Royal medal, and thereby determined my career. But, having long retired into the position of a veteran, I confess I was extremely astonished—I honestly also say that I was extremely pleased—to receive the announcement that you had been good enough to award to me the Darwin medal. But you know the Royal Society, like all things in this world, is subject to criticism. I confess that with the ingrained instincts of an old official that which arose in my mind after the reception of the information that I had been thus distinguished was to start an inquiry which I suppose suggests itself to every old official—How can my government be justified? In reflecting upon what had been my own share in what are now very largely ancient transactions it was perfectly obvious to me that I had no such claims as those of Mr. Wallace. It was also perfectly clear to me that I had no such claims as those of my life-long friend Sir Joseph Hooker, who for twenty-five years placed all his great sources of knowledge, his sagacity, his industry, at the disposition of his friend Darwin. And really, I began to despair of what possible answer could be given to the critics whom the Royal Society, meeting as it does on November 30, has lately been very apt to hear about on December 1. Naturally there occurred to my mind that famous and comfortable line, which I suppose has helped so many people under like circumstances, "They also serve who only stand and wait." I am bound to confess that the standing and waiting to which I refer, has been, so far as I am concerned, of a somewhat peculiar character. I can only explain it, if you will permit me to narrate a story which came to me in my old nautical days, and which, I believe, has just as much foundation as a good deal of other information which I derived at the same period from the same source. There was a merchant ship in which a member of the Society of Friends had taken passage. That ship was attacked by a pirate, and the captain thereupon put into the hands of the member of the Society of Friends a pike, and desired him to take part in the subsequent action, to which, as you may imagine, the reply was that he would do nothing of the kind; but he said that he had no objection to stand and wait at the gangway. He did stand and wait with the pike in his hand, and when the pirates mounted and showed themselves coming on board, he thrust his pike (with the

sharp end forward) into the persons who were mounting, and he said, "Friend, keep on board thine own ship." It is in that sense that I venture to interpret the principle of standing and waiting to which I have referred. I was convinced as firmly as I have ever been convinced of anything in my life that the "Origin of Species" was a ship laden with a cargo of great value, and which, if she were permitted to pursue her course, would reach a veritable scientific Golconda, and I thought it my duty, however naturally averse I might be to fighting, to bid those who would disturb her beneficent operations to keep on board their own ship. If it has pleased the Royal Society to recognise such poor services as I may have rendered in that capacity I am very glad, because I am as much convinced now as I was thirty-four years ago that the theory propounded by Mr. Darwin, I mean that which he propounded —not that which has been reported to be his by too many ill-instructed, both friends and foes—has never yet been shown to be inconsistent with any positive observations, and if I may use a phrase which I know has been objected to and which I use in a totally different sense from that in which it was first proposed by its first propounder, I do believe that on all grounds of pure science it "holds the field," as the only hypothesis at present before us which has a sound scientific foundation. It is quite possible that you will apply to me the remark that has often been applied to persons in such a position as mine, that we are apt to exaggerate the importance of that to which our lives have been more or less devoted. But I am sincerely of opinion that the views which were propounded by Mr. Darwin thirty-four years ago will be understood hereafter to mark an epoch in the intellectual history of the human race. They will modify the whole system of our thoughts and opinions, and shape our most intimate convictions. I do not know, I do not think anybody knows, whether the particular views which Darwin held will be fortified by the experience of the ages which come after us. But of this thing I am perfectly certain, that the present state of things has resulted from the feeling of the smaller men who have followed him that they are incompetent to bend the bow of Ulysses, and in consequence many of them are preferring to employ the air-gun of mere speculation. Those who wish to attain to some clear and definite solution of the problems which Mr. Darwin was the first person to set before us in later times, must base themselves upon the facts which are stated in his great work, and, still more, must pursue their inquiries by the methods of which he was so brilliant an exemplar throughout the whole of his life. You must have his sagacity, his untiring search after the knowledge of fact, his readiness always to give up a preconceived opinion to that which was demonstrably true, before you can hope to carry his doctrines to their ultimate issue; and whether the particular form in which he has put them before us may be such as is finally destined to survive or not is more, I venture to think, than anybody is capable at this present moment of saying. But this one thing is perfectly certain—that it is only by pursuing his methods, by that wonderful single-mindedness, devotion to truth, readiness to sacrifice all things for the advance of definite knowledge, that we can hope to come any nearer than we are at present to the truths which he struggled to attain.

THE BATTLE OF THE FORESTS.[1]

II.

IN the sand-hills which traverse Nebraska from east to west there are now found in eastern counties the sand-drowned trunks of the western bull pine, and the same pine belonging to the Pacific flora is found associated with the black walnut of the eastern region along the Niobrara River.

We may, however, divide the North American forest, according to its botanical features, into two great forest regions, namely, the Atlantic, which is in the main characterised by broad-leaved trees, and the Pacific, which is made up almost wholly of coniferous species.

In the Atlantic forest we can again discern several floral subdivisions, each of which shows special characteristics. The southernmost coast and keys of Florida, although several degrees north of the geographical limit of the tropics, present a truly tropical forest, rich in species of the West Indian flora, which here finds its most northern extension. There is no good reason for calling this outpost semi-tropical, as is done on Sargent's map. With the mahogany, the mastic, the royal palm, the mangrove, the sea grape, and some sixty more West Indian species represented, it is tropical in all but its geographic position. That the northern flora joins the tropic forest here, and thus brings together on this insignificant spot some hundred species, nearly one quarter of all the species found in the Atlantic forest, does not detract from its tropical character.

On the other hand, the forest north of this region may be called sub-tropical, for here the live and water oak, the magnolia, the bay tree and holly, and many other broad-leaved trees are mixed with the sabal and dwarf palmatto. As they retain their green foliage throughout the winter, this region is truly semi-tropical in character, and under the influence of the Gulf Stream, extends in a narrow belt some twenty or twenty-five miles in width along the coast as far north as North Carolina.

While this ever-green, broad-leaved forest is more or less confined to the rich hammocks and moister situations, the poor sandy soils of this as well as of the more northern region are occupied by pines; and as those, especially the long leaf pine, are celebrated all over the world, and give the great mercantile significance to these forests, this region may well be called the great southern pine belt. North of the evergreen subtropic forest stretches the vast deciduous leaved forest of the Atlantic, nowhere equalled in the temperate regions of the world in extent and perfection of form, and hardly in the number of species. This designation applies to the entire area up to the northern forest belt, for the region segregated on the census map as the northern pine belt is still in the main the dominion of the deciduous-leaved forest trees. On certain areas pines and spruces are intermixed, and on certain soils, especially gravelly drifts and dry sand plains, as on the pine barrens of Northern Michigan, they congregate even to the exclusion of other species. Instead, we can divide this deciduous-leaved forest by a line running somewhere below the fortieth degree of latitude, where with the northern limits of the southern magnolias and other species we may locate in general the northern limit of the southern forest flora. Northward from here, in what may be called the "middle Atlantic forest," the deciduous species rapidly decrease, and the coniferous growth predominates, until we arrive at the broad belt of the northern forest, which, crossing from the Atlantic to the Pacific, and composed of only eight hardy species, takes its stand against the frigid breath and icy hands of Boreas.

Abounding in streams, lakes, and swampy areas, the low divides of this region are occupied by an open stunted forest of black and white spruce, while the bottoms are held by the balsam fir, larch or tamarack, poplar, dwarf birch and willow. The white spruce, paper or canoe birch, balsam poplar and aspen stretch their lines from the Atlantic to the Pacific over the whole continent.

On the Pacific side the subdivisions are rather ranked from west to east. While the northern forest battles against the cold blasts from icy fields, the front of the Pacific interior forest is wrestling with the dry atmosphere of the plains and interior basin. Here, on the driest parts, where the sage brush finds its home, the ponderous bull pine is the foremost fighter, and where even this hardy tree cannot succeed in the interior basin several species of cedar hold the fort, in company with the nut pine, covering with an open growth the mesas and lower mountain slopes. Small and stunted, although of immense age, these valiant outposts show the marks of severe struggles for existence.

On the higher, and therefore moister and cooler elevations, and in the narrow canyons, where evaporation is diminished and the soil is fresher, the sombre Douglas, Engelmann, and blue spruce, and the silver-foliaged white fir, join the pines or take their place.

With few exceptions, the same species, only of better development, are found in the second parallel, which occupies the western slopes of the Sierra Nevada. Additional forces here strengthen the ranks, the great sugar pine, two noble firs, a mighty larch, hemlocks and cedars vie with their leaders, the big sequoias, in showing of what metal they are made. The third parallel, occupied by the forest of the Coast Range, the most wonderfully developed, although far from being the most varied of this continent, is commanded by the redwood, with the tide-land spruce, hemlock, and gigantic arborvitæ joining the ranks.

[1] A lecture delivered by Prof. B. E. Fernow, Chief of the Forestry Department of Agriculture, U.S.A., during the Brooklyn meeting of the American Association for the Advancement of Science. (Continued from page 119.)

Broad-leaved trees are not absent, but so little developed in comparison with the mighty conifers that they play no conspicuous part except along the river bottoms, where the maple, cottonwood, ash, and alder thrive, and in the narrow interior valleys, where an open growth of oak is found. Towards the south and on the lower levels these broad-leaved trees again become evergreen, as on the Atlantic side, but of different tribes, and form a sub-tropic flora.

Along the coast we find several species of true cypress, including the well-known, although rare, Monterey cypress, which clings to the gigantic rocks, and braves the briny ocean winds, and with its branches twisted landward. Finally, flanking the battle order of the Pacific forest, we find another section of the army, composed of the northern extension of the Mexican flora, mingled with which are species from the Pacific forest on the west, and from the Atlantic on the east.

The mesquite and some acacias, the tree yuccas and the giant or tree cactus are perhaps the most characteristic and remarkable species of the deserts of this region, while the high mountains support dense forests of firs and pines.

So far we have considered the forest only from the geographical and botanical point of view, and have watched the history of its struggle for existence against the elements and against the lower vegetation and other forces of nature. A new chapter of its life history, which we shall have time only to scan very briefly, began when man came upon the scene, and the economic point of view had to be considered.

For ages man has taken sides against the forest. Not only has he contested for the occupancy of the soil, in order to cultivate his crops or to make the meadow for his cattle—a most legitimate and justifiable proceeding—and not only has he utilised the vast stores of wood accumulated through centuries, for the ten thousand uses to which this material can be applied, and in the application of which he exhibits his superior intelligence, but he has also shown a woeful lack of intelligence in the wilful or careless destruction of the forest without justifiable cause, and by just so much curtailing the bountiful stores provided by nature for him and his progeny. Not only has he, like a spendthrift, wasted his stores of useful material, but more—he has wasted the work of nature through thousands of years by the foolish destruction of the forest cover, wresting from it the toilsomely achieved victory over the soil. He has destroyed the grasses and even all vestige of vegetation, and has handed over the naked soil to the action of wind and water. As the fertility and agriculture of the plain is dependent upon the regular and equable flow of water from the mountains, such as a forest cover alone can secure, he has by barring the slopes accomplished in many localities utter ruin to himself, and turned them back into inhospitable deserts as they were first before the struggle of the forest had made them inhabitable.

One would hardly believe that certain mountains in France had ever seen a luxuriant forest growth, and could during historic times have been so utterly despoiled of their vegetal cover. Yet axe, fire, and cattle have been most successful, and the consequences have been felt not only in the mountains, but in the valleys below. The waters in torrents have brought down the soil and débris, covering out of sight the fertile fields of thousands of toiling farmers. They themselves have brought this ruin upon them on account of their ignorance of the relation of forest cover to their occupation. Now, with infinite hard work and expenditure of energy and money, the slow work of restoring the forest to its possession has begun. The first work is to take care of the rain-waters, and by artificial breaks turn them from rushing torrents over the bare surface into a succession of gentle runs and falls by fascine and stone works. This work must be begun at the very top of the mountains, at the very source of the evil, where the water receives its first momentum in the descent to the valley. The fascines or wattles, laid across each rivulet at more or less frequent distances from each other, and fastened down by heavy stones, are made of live willows or other readily sprouting species, which in course of time strike root and become living barriers. The pockets behind these breastworks gradually fill up, and the contour of the mountain-side is changed from an even and rapid descent into a series of steps with gentle fall, over which the formerly rushing waters, gradually and without turbulence, find their way to the valley below. Where the incline is too steep, and higher breastworks are necessary, they are made of masonry, sometimes at great expense. At the base of these overflow dams an opening is left for the water to drain through, even after the depression behind the rampart has filled up with débris, and soil has washed down from above. Then, when in this way the soil has come to rest, forest planting begins, and gradually the torrent is "drowned in vegetation." Sometimes, where on a steep mountain-side the naked rock alone has been left, it becomes necessary to carry in baskets the soil to the trenches hewn in the rock, where the little seedlings may take their first hold, until they are strong enough to fight their own battle and make their own soil, gradually restoring the beneficent conditions which nature had provided before the arrival of man and his senseless, improvident, self-destructive greed. By the irrational destruction of the forest, first for the supply of timber, then through the careless use of fire, by the clearing for unsuitable farm use, by excessive grazing of sheep and goat, the mountain-sides themselves are not only devastated and made useless, but fertile farms for two hundred miles from the source of the evil are ruined by the deposits of débris, and the population pauperised and driven from their homes. Many millions of dollars have been and many more will have to be spent before these regions become habitable again.

That we are working in this country towards the same conditions is too well known to need rehearsal. Go to the shores of Lake Michigan, or visit the coast of New England, New Jersey, Pennsylvania, down to the Gulf, and you can see the destructive action of the shifting sands set loose by improvident removal of the plant cover. Go to the Adirondacks, the highlands of Mississippi, or the eastern slopes of the Rocky Mountains, and aspects similar to those derived from France will meet your view.

What the farmer has brought upon himself here by excessive clearing, the lumberer, prospector, miner, or hunter prepares in the farthest West by reckless and purposeless use of fire. Burnt mountain-sides, where no living thing can subsist in comfort, cover not acres but hundreds of square miles in the western country. While the first fire only deadens the trees or undermines their constitution, the second or third fire usually is sufficient to kill what remain alive, and even to clean up the fallen timber. That these bald spots are not more frequent than they are, is only due to the short period of our endeavours in disturbing the balance of nature.

But as our nation prides itself on the rapidity of its development, exercising to the utmost our constructive energies, so do we excel in destructive and wasteful energies and tendencies, and we shall come to grief with our resources much sooner than some of our happy-go-lucky friends would like to make us believe. While these exhibitions of American vandalism are beyond the proprieties of legitimate warfare, there is not much more propriety or intelligence visible in the manner in which we levy tribute from the forest for our legitimate needs. Forests grow to be used, but there is a great difference between intelligent and unintelligent use. Improvidence and ignorance characterise the present methods of using the forest growth. The value of it is not even known. Of the 425 or more species which are represented in the forests, not more than forty or fifty at the most are found in the markets. Although, to be sure, many of the species are of but little or no economic value, the number of the truly useful trees is probably twice or three times as great as that actually used. Ignorance as to the true value of them keeps many from little more than simply a strictly local use, or from their most fit employment. The story of the black walnut used for fence rails or firewood is well known. Six years ago the red gum or liquidambar, now a fashionable finishing material, was despised. Ten years ago large hemlock trees were mouldering in the woods after the bark had been taken for tanning purposes because the value of the wood was unknown. Cypress and Douglas spruce cannot yet overcome the prejudice of the market. On the other hand, cottonwood and tulip poplar, not long ago among the despised or only locally used, can hardly now be furnished in sufficient quantities, and the long leaf pine, which had been bled for turpentine, was considered an inferior material, which, as has lately been shown, is nothing but an unwarranted prejudice.

In a vague empirical way the choice of the useful has been attempted, and only lately have we begun to systematically study our forest resources, to determine the qualities and adaptabilities of our timbers, and to find out the conditions under which they produce not only the largest amount but the best quality of timber.

Yet in another direction do the forest users act unintelligently.

As we have seen, most of our forest trees are of a social character. With few exceptions, they keep company with other kinds than their own; they appear in mixed forests. Hence, where certain species, as the pines and spruces, become gregarious, and form unmixed, pure forests, the axe of the lumberer does not as a rule level the entire forest, but he selects the kinds which he wishes to use—he culls the forest. At first sight this would appear rather an advantage for the existence of the forest. So it is from a botanic, geographic, or landscape point of view, yet from an economic point it is exactly the reverse—it is disastrous.

In the well-managed forests of Germany the undeserving species are exterminated, and the most useful fostered, just as the agriculturist exterminates the weeds and cultivates the crop. Not only is the forest there confined to those soils and locations which cannot be used to better advantage, or which require a forest cover in order to protect the soil against detrimental displacement, but it is so managed as to become a more and more valuable resource, a crop of increasing importance, under the management of skilled foresters, of whom, in a late debate on the floor of the Landtag of Prussia, it was said that "While most other productive business has declined, the forest administration has steadily improved and yielded increasing revenues."

The battle of the forest in this country is now fought by man, the unintelligent and greedy carrying on a war of extermination, without the knowledge that victory may lead eventually to their own destitution; the intelligent and provident trying to defend the forest cover, and endeavouring to prevent its removal from such lands as cannot serve a better purpose, and to restrict the use of the balance to such rational harvest of its material, without injurious effects on soil and water conditions, as will insure an ever reproducing crop and a permanent national resource.

While man may study the geography of the earth as it exists, here is about the only opportunity for him to make geography, to shape the surface conditions of the earth, and even to some extent influence its climatic conditions.

The lecturer then referred to the Adirondacks in particular, showing views of forest destruction by fire, water storage, and lumbering, and claiming that they need especially conservative treatment, because the soil itself there is made by the forest, the duff covering the native rock formed at the rate of one foot in 300 to 500 years by the decay of foliage and litter, and hence its loss by washing of the rains is practically irremediable.

He showed the paramount interest which the State has in maintaining favourable forest conditions, and claimed that the private owners, being naturally interested mostly in the timber only, and not caring for the future generations or distant and indirect benefits to others, could not be expected to manage conservatively.

Let it not be overlooked, that the State is not only the representative of communal interests as against individual interests, but also of future interest as against the present; the private interest is not sufficient to protect this class of lands; that State ownership or, what is more objectionable and less effective, State supervision of private forest lands is indispensable in those regions where the forest subserves other functions than that of mere material supply.

Grant for once that the community is interested in the preservation of the forest cover and its rational use with proper regard to the maintenance of permanently beneficial conditions, that the community would suffer from a destructive policy in those watersheds, and you must come to the logical conclusion that the community alone can be expected to guard its interests, that the community, the State, must own and manage these woods.

This does not mean that the same should be kept in virgin condition and unused, that the timber should be left to rot, and the productive capacity of nature's forces be allowed to go to waste, but that a conservative management be instituted, keeping in view both the indirect and the direct benefits of the forest cover, utilising the crop without detriment to the forest conditions.

This, to be sure, is not done by such rules of thumb as a restriction to cutting trees of given diameter, nor can the legislator prescribe to the forest how to grow. He cannot be expected to legislate how many trees to cut, how many to leave, or to lay down rules of technical forest management, any more than he would attempt to prescribe the size of the pillars supporting the roof of the Capitol, or to legislate on the proportions of an arch. It requires the knowledge, the experience, the skill of a professional, technically educated engineer, just as an effective management of the forest requires the knowledge, the experience, the skill of professional foresters, and may not be left to the ignorance and carelessness of the wood-chopper.

May the wisdom of the people of New York, of their legislators and executive officers, be equal to the difficulties of solving the problem as a business proposition, and settling it in a common-sense, business-like manner. May their intelligence and business capacity at least equal that of other States and nations, and forestall the disastrous consequences that follow unavoidably from neutrality or improper partisanship in this battle of the forest.

THE RELATION OF ENERGY OF COMBINATION TO ELECTRICAL ENERGY.

THE problem of directly converting the stored-up energy of coal into available electrical energy is one of great importance; and as a first attempt to perform this operation, the experiments made by Dr. W. Borchers, of Duisburg, and which he described before the first annual meeting of the Deutsche Elektrochemische Gesellschaft, possess great interest. The author in the first place produced an electric current by the "combustion" of carbonic oxide gas. The original form of the apparatus used consisted of a glass vessel divided into three compartments by two glass plates which nearly reached to the bottom of the vessel. In the two exterior compartments copper tubes were placed, which served for the introduction of the carbonic oxide, while the middle compartment contained a bell-shaped mass of carbon. This carbon bell constituted one plate of the cell, and the oxygen was introduced by means of a tube within this bell. As electrolyte the author uses an ammoniacal or acid solution of cuprous chloride; this liquid readily absorbs both oxygen and carbonic oxide, and is therefore particularly well suited to form the electrolyte in a gas battery in which these gases are used. Coal gas which contains 5 per cent. of carbonic oxide was, after the first experiments, used in place of pure carbonic oxide. The copper tubes were weighed before and after each experiment, and no decrease in their weight was ever found. With such a cell working through an external resistance of 0·1 ohm a current of 0·5 ampere was obtained, while with an external resistance of 50 ohms the difference of potential between the terminals was 0·4 volt.

With a cell in which the outer compartments were filled with copper turnings, in order to increase the absorption of carbonic oxide by exposing a greater surface, and by using coal gas in place of pure carbonic oxide, a maximum current of 0·64 ampere was obtained, and by increasing the external resistance a maximum difference of potential of 0·56 volt was maintained. The E.M.F. obtained by calculation from the heat developed in the combination of CO and O is 1·47 volts, so that in the above experiment 27 per cent. of the energy of combination of the fuel is converted into electrical energy. Since a solution of cuprous chloride dissolves hydrocarbons, powdered coal was tried in place of carbonic oxide, when a maximum current of 0·4 ampere and a maximum E.M.F. of 0·3 volt were obtained. The above E.M.F. (0·3) corresponds to about 15 per cent. of the energy corresponding to the oxidation of carbon. In the case of the coal-dust, even when the liquid was kept in motion, there was always a considerable falling off in the current, while the pollution of the electrolyte by the coal would quite prevent its use. With the gases, however, there is no falling off of the E.M.F., and this pollution of the electrolyte does not occur.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. R. D. Roberts has been appointed chief secretary for the University Extension scheme, in the room of Mr. A. Berry, who retires at the beginning of the Lent Term 1895.

The General Board of Studies report in favour of steps being taken to establish a closer connection between Addenbrooke's Hospital and the University teachers in the departments of medicine, surgery, and therapeutics.

The Syndics for State Medicine report that in the past year fifty-six candidates presented themselves for examination in this

subject; of these thirty-two received the University's diploma in Public Health.

Mr. H. Yule Oldham, University Lecturer in Geography, has been admitted by incorporation to the degree of M.A.

The *University Reporter* of December 3 contains a full report of the speeches delivered at a meeting in King's College for the purpose of promoting the foundation of a memorial library of Oriental literature in honour of the late Prof. Robertson Smith, editor of the *Encyclopædia Britannica*.

SCIENTIFIC SERIAL.

American Meteorological Journal, November.—Cyclonic precipitation in New England, by Prof. W. Upton. A list of cyclones was made out, including nearly all in which the precipitation had been general over New England, and the amounts and distribution noted on maps, with regard to the track of the minimum pressure. The velocity with which the storms passed ranged from fifteen to sixty miles per hour. The tables show that the heaviest rainfall is rarely found along the central path of the storm. Of the cyclones which came from the west *across* New England, only ten out of sixty-nine had their heaviest precipitation on or near the storm-path, while forty-five had the maximum area on the right of the storm-track; similarly, out of eighty-four cyclones which moved from the west *near* New England, seventy-three had their maximum precipitation south of the storm-track. Further comments are reserved until the results of a study of the storms coming from the south are given.—The barometer at sea, by T. S. O'Leary. This paper deals with observations made chiefly by captains of American vessels. The author considers that a great step forward was made when the number of observations was reduced from twelve to one daily, the result being that the number of observers has increased nearly eight-fold. Another valuable feature is that the leaves of the log-books are forwarded to the central office as soon as opportunities are offered, so that the captains can see their observations made use of without delay. A simple plan for obtaining comparisons of the barometers has been adopted with very satisfactory results. The observers when in port record readings at certain hours, and forward them on post-cards to the central office; a copy of the "corrections" is immediately returned to them, and copies filed for use and future reference.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 15.—"The Pigments of the Pieridæ. A Contribution to the Study of Excretory Substances which function in Ornament." By F. Gowland Hopkins.

The wing-scales of the white Pieridæ are shown to contain uric acid, this substance practically acting as a white pigment in these insects. A yellow pigment, widely distributed in the group, is shown to be a derivative of uric acid, and its artificial production as a bye-product of the hydrolysis of uric acid is demonstrated. That this yellow pigment is an ordinary excretory product of the animal is indicated by the fact that an identical substance is voided from the rectum on emergence from the pupa.

These excretory pigments, which have well-marked reactions, are apparently confined to the Pieridæ, and are not found in other Rhopalocera. This fact enables the observation to be made that when a pierid mimics an insect belonging to another group, the pigments of the mimicked and mimicking insects, respectively, are chemically quite distinct.

Other pigments existing, not in the scales, but between the wing membranes, are described, and are shown sometimes to function in ornament. The analysis, and the properties of the yellow scale-pigment are fully discussed in the paper.

Physical Society, November 23.—Prof. Rücker, F.R.S., President, in the chair.—Mr. Womack read a paper on a modification of the ballistic galvanometer method of determining the electromagnetic capacity of a condenser. The condenser is placed in parallel with one arm (S) of a Wheatstone's bridge arrangement of non-inductive resistances. A balance for steady currents having been obtained, the condenser is placed in circuit, and the throw on depressing the battery key determined. The condenser is then thrown out of circuit, and the proportionality of the arms of the bridge disturbed by changing the value of S to S + dS. The steady deflection due to this change is then read. From these two readings and the known values of S and dS the capacity is immediately determined. In practice readings of deflection may be taken with equal positive and negative values of dS. To avoid changes of E.M.F. of the battery, the author finds it best to use a reversing key in the battery circuit, and to observe the throw on reversing the current instead of on simply breaking it. One advantage of the method is that there is no need to know the galvanometer- or battery-resistance, and the author points out that it may be of service in the simultaneous determination of the resistance and of the joint capacity and inductance of a submarine cable or of a telephone or telegraph line. Prof. Perry asked what were the advantages of the method as compared with the Rayleigh-Sumpner method. Mr. Blakesley thought that the correction for damping in the ballistic part of the experiment might be avoided if in the second part the disturbance of balance due to the increment dS were measured by half the first throw of the needle on making the galvanometer circuit, instead of by the steady deflection. He doubted whether reversing the current in the battery circuit would have just twice the effect of simply breaking the circuit. In reply, Mr. Womack said he had not tried the method of reading suggested by Mr. Blakesley, but with regard to the reversing of the battery circuit, that was found to give in practice as nearly as possible twice the deflection which resulted from simply breaking.—A paper, by Prof. S. P. Thompson and Mr. Miles Walker, on mirrors of magnetism, was read by Prof. Thompson. It was pointed out that, corresponding to the theory of electric images produced by insulated conductors, there is a theory of magnetic images produced by bodies of infinite magnetic permeability. A magnet pole in the latter theory is the analogue of an electric charge in the former, and a body of infinite magnetic permeability is the analogue of an insulated conductor (which is electrostatically indistinguishable from a body of infinite dielectric capacity). Experiments were made to determine how far the magnetic images due to thick sheets of iron accorded with those deduced by theory for the case of infinite permeability. The image of a north pole in an infinite plane sheet should consist of a south pole of the same strength at a point coinciding with the optical image of the north pole, together with an equal north pole distributed uniformly over the surface of the infinite sheet, as a free electrical charge would be, and so exerting no finite action. Working at distances of a few inches in front of the surface, a sheet of iron a few feet in length and breadth, and a couple of inches thick, was found to realise the theoretical conditions with very tolerable exactness. In a coil of wire placed on one side of the sheet a current was started or stopped, and the electromotive impulse produced in a subsidiary exploring coil was detected by means of a ballistic galvanometer. That the effect of the actual mirror was equivalent to that of the theoretical image, was verified by substituting for the iron a coil equal and similar to the first, and coinciding with its optical image. Sending the same primary current as before round the two coils (with due regard to its direction in the second coil), hardly any appreciable difference in the secondary impulse was observed. This was found to hold good whether the original primary coil had its axis perpendicular or oblique to the plane of the magnetic mirror. Some observations on spherical sheets were also recorded, but in this case the conclusions were less simple. The paper was followed by a discussion, in which Mr. Boys, Prof. Perry, Prof. Ayrton, Dr. Burton, Mr. W. Bailey, and Prof. Carey Foster took part.—Prof. Ayrton exhibited a student's apparatus for verifying Ohm's law, designed by himself and Mr. Mather. The current flowing through a circuit is to be measured (not necessarily in terms of any defined unit) by means of a galvanometer, while the potential-difference between two fixed points is measured by means of an idiostatic electrometer. Within small limits of experimental error, the current and potential-difference are found to vary in the same proportion; but the electrometer and its manner of use constituted the chief interest of the paper. The fixed and moving parts (inductors and needle) are alike cylindrical in form (the term being understood in its most unrestricted sense), and the generating lines are vertical. There is a vertical axis of symmetry, such that the disposition of these cylindrical parts would remain unchanged if the instrument were rotated through 180° about the axis. The needle is hung by a very thin phosphor-

bronze strip, and to obtain a reading when it differs in potential from the inductors by an amount which we have to measure, it is brought back to its ordinary zero position by turning a torsion-head to which the upper end of the suspending strip is fixed. The potential-difference is then proportional to the square root of the angle through which the torsion-head has been turned, but the E.M.F. of a moderate battery of accumulators can be read with very fair accuracy. The authors have bestowed great care on the design of the needle, so that, for a given potential-difference, the turning-moment divided by the moment of inertia may be as great as possible. The whole instrument is protected from external inductive influence by having the inner surface of its glass case coated with a transparent conducting varnish, which Prof. Ayrton has described elsewhere.—Prof. Ayrton also showed an idiostatic electrometer, whose needle, instead of being suspended, was pivoted on an axle. The instrument is rapid and nearly dead-beat in action, and gives a scale-reading of about three inches for an E.M.F. of 100 volts. Prof. S. P. Thompson expressed great admiration for the instruments exhibited, but denied that the law which they served to prove was Ohm's law at all; and this led to some discussion as to what Ohm's law really is. Prof. Ayrton briefly replied.

Chemical Society, November 1.—Dr. Armstrong, President, in the chair.—The following papers were read: The electromotive force of alloys in a voltaic cell, by A. P. Laurie.—Determinations of the E.M.F. developed by sixteen alloys of the heavy metals confirm Matthiessen's conclusion that the tin-gold alloy is the only definite compound amongst them.—A product of the action of nitric oxide on sodium ethylate, by G. W. MacDonald, and O. Masson. Nitric oxide is absorbed by an alcoholic solution of sodium ethylate with formation of an explosive salt, probably the sodium salt of methylenedihydroxynitrosamine, $CH_2[N(NO)OH]_2$. The incomplete combustion of some gaseous carbon compounds, by W. A. Bone and J. C. Cain. When a hydrocarbon containing n atoms of carbon is burnt with n atoms of oxygen, the interaction may be represented by the following equation: $C_nH_x + O_n = nCO + \frac{x}{2}H_2$.—Derivatives of tetramethylene, by W. H. Perkin, jun. A number of halogen and hydroxy-derivatives of tetramethylene and tetramethylenedicarboxylic acid are described. Pentamethylenedicarboxylic acid,

$$CH_2\left\langle\begin{array}{l} CH_2 . CH . COOH \\ \qquad\;\;\, | \\ CH_2 . CH . COOH \end{array}\right.$$

, by E. Haworth and W. H. Perkin, jun. A number of derivatives of this acid are described.—Substituted pimelic acids, by A. W. Crossley and W. H. Perkin, jun. The authors have succeeded in preparing ethyl- and methylethyl-pimelic acid, and also describe several other new aliphatic acids.—Homologues of butanetetracarboxylic acid and of adipic acid, by B. Lean. The disodio-derivative of ethylic butanetetracarboxylate reacts readily with the alkylic iodides or chlorides yielding derivatives which on hydrolysis are converted into tetracarboxylic acids of the constitution, $CR(COOH)_2 . CH_2 . CH_2 . CR(COOH)_2$; on heating these acids, di-substituted adipic acids are obtained.—Contributions to the chemistry of cellulose. (1) Cellulose sulphuric acid, and the products of its hydrolysis, by A. L. Stern. Cellulose disulphuric acid, $C_6H_8O_3(HSO_4)_2$, is obtained by dissolving cellulose in sulphuric acid; on hydrolysis, it yields first cellulose monosulphuric acid, and then products containing less sulphur.—The chlorination of aniline, by J. J. Sudborough.—Condensation of benzil with ethyl malonate, by F. R. Japp and W. B. Davidson. Benzil and ethylic malonate condense yielding monoethylic benzoïnylmalonate $COPh . CPh(OH) . CH(COOH)COOEt$, and desylenemalonic acid $COPh . CPh : C(COOH)_2$.

Linnean Society, November 15.—Mr. C. B. Clarke, F.R.S., President, in the chair.—Mr. J. E. S. Moore exhibited preparations illustrative of his investigations concerning the origin and nature of the achromatic spindle in the spermatocytes of elasmobranch fishes. His results were approximately in agreement with those arrived at by Hermann in regard to the corresponding elements in amphibia, and more in accord with those of Ishikawa relating to the division of noctiluca. As to the spindle fibres themselves, it appeared that during the diastral stage of the division they were the optical expression of thickenings in the wall of a membranous cylinder stretched out between the chromosomes.—The Rev. G. Henslow exhibited some curious iron implements of somewhat varied pattern, used in Egypt for cutting off the top of the Alexandrine fig, *Ficus Sycamorus*, Linn., the operation being necessary to render it edible by getting rid of the parasitic insect *Sycophaga crassipes*, Westwood, with which it is always infested. The practice was said to be very ancient, being described by Theophrastes, and alluded to by the same word, κνίζων, in the septuagint version of the Old Testament (Amos vii. 14) in translating from the Hebrew.—Mr. H. N. Ridley showed some drawings of the green larva of a sphinx moth mimicking a green tree snake, *Trimeresurus Wayleri*, as well as a cluster of caterpillars mimicking a fruit, all of which were found in Singapore. He also exhibited a drawing from life of the tan-producing gambir-plant (*Uncaria Gambir*) in flower.—Mr. Thomas Christy exhibited some germinating seeds of pepper showing the testa being carried up by the cotyledons.—A paper was then read by Dr. D. Prain, on the plant-yielding Bhang *Cannabis sativa*. Illustrating by lantern slides the anatomy of flower and fruit in *Cannabis*, he reviewed the theories propounded of theirstructure; confirmed from teratology those of Payer (1857) and Celakovsky (1875), and refuted those of B. Clarke (1853) and Macchiati (1889). He then explained (1) the prevention of fertilisation for development of narcotic properties, and (2) of the various forms of the narcotic to each other. A series of monœcious conditions described in plants of both sexes show that the so-called ♂ flower is probably an inflorescence, the perianth segments being bracts, not sepals, while the stamen is the homologue of the anterior sterile carpel of the ♀ flower.—A paper, on the proposed revision of the British Copepoda, by Mr. Thomas Scott, was, in the unavoidable absence of the author, read by the secretary.

Geological Society, November 21.—Dr. Henry Woodward, F.R.S., President, in the chair.—The Pleistocene beds of the Maltese Islands, by John H. Cooke. An especially noticeable feature of these beds is the absence of ordinary anticlinal and synclinal folding, and the predominance of monoclinal faults, which largely affect the character of the surface. These faults were formed prior to the deposition of the Pleistocene beds. The plateaux of Malta, rising to a height of 600–800 feet above sea-level, occur south of the great east-and-west fault, which has a downthrow to the north. They have no Pleistocene deposits upon their summits. Three classes of superficial deposits were described, namely: (1) Valley-deposits; (2) agglomerates and breccias found along coast-lines and fault-terraces, always at the foot of the fault-terraces, or along the lower slopes of the depressed areas; (3) ossiferous deposits of caves and fissures.—Geological notes of a journey in Madagascar, by the Rev. R. Baron.—On a collection of fossils from Madagascar obtained by the Rev. R. Baron, by R. Bullen Newton.

Mineralogical Society.—Anniversary meeting, November 20.—Prof. N. S. Maskelyne, F.R.S., President, in the chair.—The annual report of Council was read and adopted.—The following were elected ordinary members of Council: Prof. A. H. Green, F.R.S., Mr. A. Harker, Mr. A. E. Tutton, and Mr. W. W. Watts, in place of the four retiring members; in other respects the list of officers and Council remains unchanged. The following papers were read: On cone-in-cone structure, by the Rev. Prof. T. G. Bonney, F.R.S.; confirming and extending the views previously published by Prof. Cole.—On a basic ferric sulphate from Parys Mount, Anglesey, by Prof. A. H. Church, F.R.S.; containing the analysis of an earthy mineral corresponding to a compound of one molecule of coquimbite with five molecules of normal ferric hydrate.—Augelite, by Mr. G. T. Prior and Mr. L. J. Spencer; containing a full account of the chemical, physical and crystallographical characters of specimens from Machacamarca, Bolivia, of a mineral previously described only from massive material found in Sweden.—On the occurrence of delessite in Cantyre, by Prof. M. F. Heddle and Mr. J. S. Thomson; containing two analyses of the mineral.—Specimens of augelite, and of a beautiful opal cast of a bivalve from Australia, were exhibited.

PARIS.

Academy of Sciences, November 26.—M. Lœwy in the chair.—Photographic studies of some parts of the lunar surface, by MM. Lœwy and Puiseux. The need of care in interpreting photographs taken under ordinary conditions is emphasised; the many ways in which accidental circumstances may produce

markings in the photographic film corresponding to no real object render it essential that the more obscure details shall be fully confirmed by a close correspondence in form and extent on different negatives. Again, the tendency to aggregation of the reduced silver in the negative destroys all value in enlargements carried beyond a certain limit, say thirty or forty times the original size. Certain clear negatives, obtained at Paris on February 13 and March 14, have been enlarged by Dr. Weinek and compared with the best maps of the corresponding region, with the result that many new details, fully described in the paper, have been added to our knowledge of the moon's surface.—A note on the calculation of the orbits of planets, by M. F. Tisserand.—An observation of Wolf's planet (1894, B E), made with the Bordeaux equatorial, by M. G. Rayet.—On the laws of air resistance, by M. E. Vallier. Formulæ are derived which express the specific resistance of air to a moving body (*a*) where the velocity is greater than 330 metres, (*b*) where the velocity is between 330 and 100 metres, and (*c*) where the velocity is less than 100 metres per second.—New details concerning the Nymphæinæ; tertiary Nymphæinæ, by M. G. de Saporta.—The elements of the planet B E, by M. L. Schulhof.—Observations of Swift's new comet E (1894, November 20) from the Paris Observatory, by M. G. Bigourdan.—On the distribution of planets between Mars and Jupiter, by M. E. Roger. A mathematical paper in which the author endeavours to obtain, from the known distribution of the minor planets, some support for a hypothesis formulated in a previous communication (*Comptes-rendus*, t. cxvi.).—On the movement of a solid body, by M. G. Kœnigs.—On an application of the principle of areas, by M. L. Lecornu.—On functional equations, by M. Leau.—On Bertrand's theorem, by M. Cartan.—A *réclamation* concerning M. P. Stäckel's note on the problems of dynamics of which the differential equations admit an infinitesimal transformation. M. Otto Staude published a paper on this subject in 1892. M. Stäckel merely extended the theorems therein demonstrated from two and three to *n* variables.—On the tempest of November 12, 1894, by M. Alfred Angot. A tabular comparison is made between data obtained at the Meteorological Bureau and on the Eiffel Tower respectively. Interesting conclusions are drawn from the tower observations, which are free from the disturbances ordinarily brought in owing to the nearness of the surface of the soil.—On the conversion of propionic acid into lactic acid, by M. Fernand Gaud. By heating a mixture of 10 per cent. of propyl alcohol with Fehling's solution for 200 hours at 240°, the author has obtained both the ordinary and isomeric lactic acids. As metallic copper is produced on heating copper propionate with excess of water at 200°, the equation representing the production of the lactic acid must be written $2(C_3H_5O_2)_2Cu + 2H_2O = 2Cu + 2C_3H_6O_3 + 2C_3H_6O_2$.—On the ethereal salts derived from active amyl alcohol, by MM. Ph. A. Guye and L. Chavanne. The specific rotations are given for a number of these esters, the maximum value is obtained for the fatty salts with amyl propionate. The product of asymmetry reaches its maximum with amyl acetate.—On the so-called organic chlorine of the gastric juice, by M. H. Lescœur. A direct method of determining *organic chlorine* is described, and it is pointed out that the *organic* chlorine of MM. Hayem and Winter is partly derived from ammonium chloride, which is itself partly formed at a high temperature from the sodium chloride present.—On the composition of the red pigment from *Diemyctylus viridescens*, by M. A. B. Griffiths. The analytical results give the formula $C_{20}H_{18}N_2O_7$ for die nyctyline.—On acid leathers, by MM. Balland and Maljean.—A new entoptical phenomenon, by M. S. Tchiriew.—The principles of chroology or physiological synthesis of colour, by M. W. Nicati.—On the effects of ablation of the venom-glands in the viper (*Vipera Aspis*, Linn.), by MM. C. Phisalix and G. Bertrand.—Contributions to the study of the "cellule conjonctive" in the molluscous Gasteropods, by M. Joannes Chatin.—A new method for the cultivation of fish-ponds, by M. Jousset de Bellesme.—The reptiles of the upper jurassic age in the Boulonnais, by M. H. E. Sauvage.—On the new ivory human statuettes from the quaternary station at Brassempouy, by M. Ed. Piette.—Influence of arsenic acid on the growth of algæ, by M. Raoul Bouilhac. It is shown that arsenic acid in certain cases acts like phosphoric acid, which it may replace in some plant cultivations.—On the age of Lake Bourget and the ancient alluvial deposits of Chambéry and the valley of the Isère, by M. A. Delebecque.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—The Province of South Australia: J. D. Woods (Adelaide, Bristow).—The Mechanism of Weaving: T. W. Fox (Macmillan).—Meteorology, Practical and Applied: Dr. J. W. Moore (Rebman).—Life of Richard Owen: Rev. R. Owen, 2 Vols. (Murray).—Elements of Astronomy: G. W. Parker (Longmans).—A Hand-book to the Order Lepidoptera. Part 1. Butterflies, Vol. 1: W. F. Kirby (Allen).—A Hand-book to the Primates: Dr. H. O. Forbes, 2 Vols. (Allen).—Ostwald's Klassiker der Exakten Wissenschaften: Nos. 54–59 (Leipzig, Engelmann).—Physikalische Krystallographie: P. Groth, Dritte Auflage, 1 and 2 Abthg. (Leipzig, Engelmann)—Grundriss der Psychologie: O. Külpe (Leipzig, Engelmann).—Portraits berühmter Naturforscher (Wien, Richler).—The Iron-bearing Rocks of the Mesabi Range in Minnesota: J. E. Spurr (Minneapolis).—Coal Deposits of Iowa: C. R. Keyes (Des Moines).—U.S. Geological Survey, Twelfth Annual Report, 1890-91. Part 1, Geology; Part 2, Irrigation (Washington),—Ditto, Thirteenth Annual Report, Part 1, Report of Director; Part 2, Geology; Part 3, Irrigation (Washington).—N.Z. Papers and Reports relating to Minerals and Mining (Wellington).—Annuaire de l'Observatoire Municipal de Montsouris, 1893 (Paris, Gauthier-Villars).—Kitchen-Boiler Explosions: R. D. Monro (Griffin).—The Elementary Properties of the Elliptic Functions; Prof. A. C. Dixon (Macmillan).—Birds of the Wave and Woodland: P. Robinson (Isbister).—Elementary Commercial Geography: Dr. H. R. Mill, 2nd edition (Cambridge University Press).—An Introduction to the Theory of Electricity: L. Cumming, 4th edition (Macmillan).—Symbolic Logic: Dr. J. Venn, 2nd edition (Macmillan).—Farm Vermin, edited by J. Watson (Rider).—The Cyclopædia of Names: edited by B. E. Smith (Unwin).

PAMPHLETS.—Geological and Natural Hisory of Minnesota: N. H. Winchell (Minneapolis).—Magnetic Observations made at the U.S. Naval Observatory during the Year 1892: Prof. S. J. Brown (Washington).—Meteorological Observations and Results, U.S. Naval Observatory, 1889 (Washington).—The Warble Fly: E. A. Ormerod (Simpkin).—American Museum of Natural History, Annual Report for 1893 (New York).

SERIALS.—Archiv für Entwickelungsmechanik der Organismen: Prof. W. Roux. Erster Band, Erstes Heft (Leipzig, Engelmann).—Studies from the Yale Psychological Laboratory, Vol. 2 (New Haven).—Biology Notes, Nos. 1 and 2 (Chelmsford).—Bulletin of the American Mathematical Society, 2nd series, Vol. 1, No. 2 (New York, Macmillan).—School Review, November (Hamilton, New York).—Journal of the College of Science, Imperial University of Japan, Vol. viii. Part 1 (Tōkyō, Japan).—Contemporary Review, December (Isbister).—Proceedings and Transactions of the Nova Scotian Institute of Science, Halifax, second series. Vol. 1, Part 3 (Halifax).—Proceedings of the American Philosophical Society, June (Philadelphia).—Transactions of the Academy of Science of St. Louis, Vol. vi. Nos. 9 to 17 (St. Louis).—Quarterly Journal of Microscopical Science, November (Churchill).—Fortnightly Review, December (Chapman).—Morphologischen Jahrbuch, 22 Band, 1 Heft (Leipzig, Engelmann).—Zeitschrift für Physikalische Chemie, xv. Band, 3 Heft (Leipzig, Engelmann).—National Review, December (Arnold).—Scribner's Magazine, December (Low).

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